QK1
.T88O5
1908
v.35

BULLETIN

OF THE

TORREY BOTANICAL CLUB

VOL 35

FOUNDED BY WILLIAM HENRY LEGGETT, 1870

EDITOR

MARSHALL AVERY HOWE

ASSOCIATE EDITORS

JOHN HENDLEY BARNHART
JEAN BROADHURST
PHILIP DOWELL
ALEXANDER WILLIAM EVANS
TRACY ELLIOT HAZEN
WILLIAM ALPHONSO MURRILL
CHARLES LOUIS POLLARD
HERBERT MAULE RICHARDS

NEW YORK
1908
PUBLISHED FOR THE CLUB
THE NEW ERA PRINTING HOUSE
LANCASTER, PA.

Mo. Bot. Garden
1909

CONTENTS

CURTIS, CARLTON CLARENCE. A biographical sketch of Lucien Marcus Underwood (portrait) - - - - - - - - - - 1

HOWE, MARSALL AVERY. Lucien Marcus Underwood: a memorial tribute - - - - - - - - - - - - - 13

BARNHART, JOHN HENDLEY. The published work of Lucien Marcus Underwood - - - - - - - - - - - 17

BRITTON, NATHANIEL LORD. Professor Underwood's relation to the work of the New York Botanical Garden - - - - - 39

BICKNELL, EUGENE P. The ferns and flowering plants of Nantucket—I. 49

ROBINSON, CHARLES BUDD. Alabastra philippinensia—I - - - 63

STANDLEY, PAUL CARPENTER. Some Echinocerei of New Mexico - - 77

HOUSE, HOMER DOLIVER. Two Bahamian species of Evolvulus - - 89

HOUSE, HOMER DOLIVER. Studies in the North American Convolvulaceae—IV. The genus Exogonium (with plates 1 and 2) - - 97

CUSHMAN, JOSEPH AUGUSTINE. The New England species of Closterium (with plates 3–5) - - - - - - - - - - 109

DOWELL, PHILIP. New ferns described as hybrids in the genus Dryopteris - - - - - - - - - - - - - 135

WESTER, P. J. Correlation of flower- and fruit-structure in Carica Papaya - - - - - - - - - - - - - 141

JACKSON, H. S. Sorosporium Ellisii Winter, a composite species - - 147

EVANS, ALEXANDER WILLIAM. Hepaticae of Puerto Rico—IX. Brachiolejeunea, Ptychocoleus, Archilejeunea, Leucolejeunea, and Anoplolepeunea (with plates 6–8) - - - - - - - - - 155

BICKNELL, EUGENE P. The ferns and flowering plants of Nantucket - 181

BRITTON, NATHANIEL LORD. The genus Ernodea: a study of species and races - - - - - - - - - - - - - 203

COOK, MELVILLE THURSTON. The development of the embryo-sac and embryo of Potamogeton lucens (with plates 9 and 10) - - - 209

BROWN, HARRY B. Algal periodicity in certain ponds and streams - - 223

BERRY, EDWARD W. Some Araucarian remains from the Atlantic coastal plain (with plates 11–16) - - - - - - - - 249

MACKENZIE, KENNETH KENT. Notes on Carex—IV - - - - - 261

HARSHBERGER, JOHN W. The water-storing tubers of plants (with plate 17) - - - - - - - - - - - - - 271

SEATON, SARA. The development of the embryo-sac of Nymphaea advena (with plates 18 and 19) - - - - - - - - 283

SETCHELL, WILLIAM ALBERT. Notes on Lycoperdon sculptum Harkness (with plate 20) - - - - - - - - - - - - 291

ZAHLBRUCKNER, A. New North American lichens - - - - - - 297

NASH, GEORGE V. Two new grasses from the West Indies - - - 301

BRITTON, N. L. The generic name Bucida - - - - - - - 303

COOK, MELVILLE THURSTON. The hypertrophied fruit of Bucida Buceras 305

SEAVER, FRED JAY. Color variation in some of the fungi - - - 307
DURAND, ELIAS J. The development of the sexual organs and sporogonium of Marchantia polymorpha (with plates 21–25) - - - 321
BRITTON, NATHANIEL LORD. Studies of the West Indian plants—I. - 337
HARPER, ROLAND M. Some native weeds and their probable origin - - 347
WILSON, GUY WEST. Studies in North American Peronosporales—III. New or noteworthy species - - - - - - - - - 361
EVANS, ALEXANDER WILLIAM. New West Indian Lejeuneae (with plates 26–28) - - - - - - - - - - - 371
MURRILL, WILLIAM ALPHONSO. Additional Philippine Polyporaceae - 391
BROOKS, CHARLES. The Fruit Spot of apples (with plates 29–35) - - 423
RYDBERG, PER AXEL. Notes on Philotria Raf. - - - - - 457
BICKNELL, EUGENE P. The ferns and flowering plants of Nantucket - 471
KERN, FRANK D. Studies in the genus Gymnosporangium - - - 499
MURRILL, WILLIAM A. The Boleti of the Frost herbarium (with plates 36–40) - - - - - - - - - - - - 517
SEAVER, FRED J. Some North Dakota Hypocreales - - - - 527
RYDBERG, PER AXEL. Notes on Rosaceae—I. - - - - - - 535
WILSON, GUY WEST. Studies in North American Peronosporales—IV. Host index - - - - - - - - - - - 543
BRITTON, NATHANIEL LORD. Studies of West Indian plants—II. - - 561
HUMPHREYS, EDWIN W. An analogy between the development of the plates of crinoids and the leaves of Sassafras - - - - 571
SEAVER, FRED J. North Dakota slime-moulds - - - - - 577
RAMALEY, FRANCIS, and DODDS, G. S. Two imperfectly known species of Crataegus - - - - - - - - - - - 581

RESOLUTIONS ADOPTED BY THE TORREY BOTANICAL CLUB AND OTHER SCIENTIFIC ORGANIZATIONS IN RELATION TO THE DEATH OF LUCIEN MARCUS UNDERWOOD - - - - - - - - - - - 41

INDEX TO AMERICAN BOTANICAL LITERATURE (1904–1907) - - - 585
INDEX TO AMERICAN BOTANICAL LITERATURE (1907) - - - - 45, 315
INDEX TO AMERICAN BOTANICAL LITERATURE (1908)
91, 151, 219, 277, 367, 417, 467, 513, 555

Dates of Publication

No. 1, for January.	Pages 1–48.	Issued February 29, 1908.
No. 2, for February.	49–96.	March 9, 1908.
No. 3, for March.	97–154.	April 20, 1908.
No. 4, for April.	155–222.	April 29, 1908.
No. 5, for May.	223–282.	May 29, 1908.
No. 6, for June.	283–320.	July 1, 1908.
No. 7, for July.	321–370.	July 30, 1908.
No. 8, for August.	371–422.	August 26, 1908.
No. 9, for September.	423–470.	September 29, 1908.
No. 10, for October.	471–516.	November 3, 1908.
No. 11, for November.	517–560.	November 30, 1908.
No. 12, for December.	561–608.	December 31, 1908.

Errata

Page 5, line 6 from bottom, *for* Exiccatae *read* Exsiccatae.
Page, 200, line 13, *for* HORDACEUS *read* HORDEACEUS.
Page 241, line 6 from bottom, for *Scenedemus* read *Scenedesmus.*
Page 313, line 11, for *Hypomyces* read *Hypocrea.*
Page 319, line 3, *add date,* D 1907.
Page 362, line 11 from bottom, *for* "on *F. floridiana* (Moq.) Nutt." *read* "On *Froelichia floridana.*"
Page 435, line 19, *for* Berk. *read* Peck.
Page 444, line 11, *for* 875 c.c. *read* 975 c.c.
Page 451, line 19, *for* stroma *read* stoma.

VOL. 35 JANUARY, 1908 NO. 1

BULLETIN

OF THE

TORREY BOTANICAL CLUB

Editor

MARSHALL AVERY HOWE

Associate Editors

JOHN HENDLEY BARNHART
JEAN BROADHURST
PHILIP DOWELL
ALEXANDER WILLIAM EVANS
TRACY ELLIOT HAZEN
WILLIAM ALPHONSO MURRILL
CHARLES LOUIS POLLARD
HERBERT MAULE RICHARDS

CONTENTS

A biographical sketch of Lucien Marcus Underwood. (Portrait)
CARLTON CLARENCE CURTIS 1

Lucien Marcus Underwood: a memorial tribute.
MARSHALL AVERY HOWE 13

The published work of Lucien Marcus Underwood.
JOHN HENDLEY BARNHART 17

Professor Underwood's relation to the work of the New York Botanical Garden. . . . . NATHANIEL LORD BRITTON 39

Resolutions adopted by the Torrey Botanical Club and other scientific organizations in relation to the death of Lucien Marcus Underwood. . . 41

INDEX TO AMERICAN BOTANICAL LITERATURE. 45

PUBLISHED FOR THE CLUB

THE NEW ERA PRINTING COMPANY
LANCASTER, PA.

THE TORREY BOTANICAL CLUB

President,

HENRY H. RUSBY, M.D.

Vice-Presidents,

EDWARD S. BURGESS, PH.D. JOHN HENDLEY BARNHART, A.M., M.D.

Recording Secretary,

C. STUART GAGER, PH.D.

Botanical Garden, Bronx Park, New York City.

Treasurer,

WILLIAM MANSFIELD, PHAR.D.

College of Pharmacy,
115 West 68th St., New York City.

MEETINGS

Meetings twice each month from October to May inclusive: the second Tuesday, at 8:00 P.M., at the American Museum of Natural History; the last Wednesday, at 3:30 P.M., in the Museum Building of the New York Botanical Garden.

PUBLICATIONS

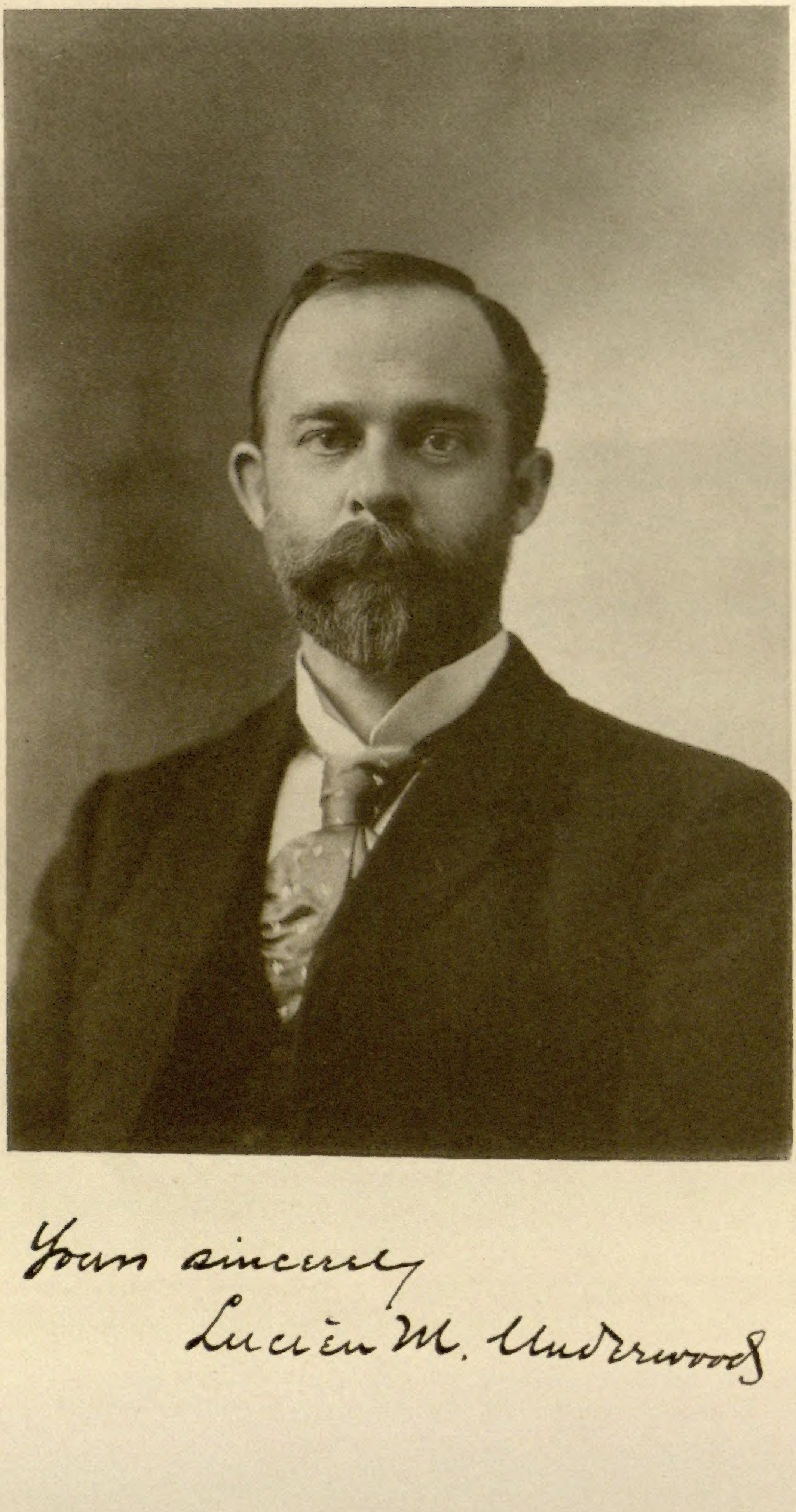
All subscriptions and other business communications relating to the publications of the Club should be addressed to the Treasurer, William Mansfield, College of Pharmacy, 115 West 68th St., New York City.

Bulletin. Monthly, established 1870. Price, $3.00 a year; single numbers 30 cents. Of former volumes, only 24–33 can be supplied separately; certain numbers of other volumes are available, but the entire stock of some numbers has been reserved for the completion of sets. Manuscripts intended for publication in the BULLETIN should be addressed to Marshall A. Howe, Editor, New York Botanical Garden, Bronx Park, New York City.

Torreya. Monthly, established 1901. Price, $1.00 a year. Manuscripts intended for publication in TORREYA should be addressed to Jean Broadhurst, Editor, Teachers College, Columbia University, New York City.

Memoirs. Occasional, established 1889. (See last pages of cover.)

Preliminary Catalogue of Anthophyta and Pteridophyta within 100 miles of New York City, 1888. Price, $1.00.



Yours sincerely

Lucien M. Underwood

Vol. 35 No. 1

BULLETIN

OF THE

TORREY BOTANICAL CLUB

JANUARY, 1908

A biographical sketch of Lucien Marcus Underwood *

CARLTON CLARENCE CURTIS

(WITH A PORTRAIT)

Lucien M. Underwood was born on October 26, 1853, in a little house still standing in the town of New Woodstock, in central New York. He died at his home in Redding, Connecticut, November 16, 1907.

From early childhood he responded to the healthful surroundings of his home and developed into a lad with a buoyancy of spirit, a whole-heartedness, and with an interest in natural objects that remained the striking characteristics of the man. In the early days of his childhood there appeared those traits and predilections that were to guide him in his life-work. As a child he played with plants, making collections of grass-leaves and other objects. As he learned to read and write, he became interested in collecting papers and documents of all kinds and would prepare lists of celebrities and of events. Later, when his school days brought him in touch with natural science subjects, the house became the repository of rocks and minerals and the laboratory for such physical and chemical experiments as his ingenuity could devise. While at work on the farm as a mere lad, it was his custom to carry in his pocket a box so that no new thing, such as an insect, could escape him. In this connection, it is noteworthy that the stories and reading that are offered to childhood did not appeal to him unless true, nor did he have any liking for his studies until late in his teens when he began such subjects as the Peck-Ganong Physics, Gray's Structural Botany, etc. These subjects completely transformed him and he became

* Read at a memorial meeting of the Torrey Botanical Club, January 29, 1908.

[The BULLETIN for December, 1907 (34: 579–630. *pl. 34*) was issued 27 F 1908.]

enthusiastic in all his studies. He would spend the lunch period in the room where the physical apparatus was stored and it was his custom to gather the botanical material for the entire class, carrying it three miles to school.

The surroundings and conditions under which he obtained his education will appear as rather strange to the youth of to-day. At five he began to attend the summer sessions at "the brick schoolhouse" of the district and so continued until he was eleven years of age, at which time he became one of the farm hands, and thenceforth time for educational work could be given him only during the winter terms. At the age of fifteen he entered Cazenovia Seminary, where he studied for two successive winters, and he was also able to pursue his work without interruption during the academic year of 1870–1871, during which session he secured the scholarship prize and the mathematical prize. An interesting record shows that he never missed a chapel or class exercise throughout this entire year, although during this student life at Cazenovia he lived at home, three miles distant, and usually walked to the seminary.

The idea of securing a college education was first suggested to him by Professor L. M. Coon (afterwards Judge Coon of Oswego) in 1870, but circumstances compelled him in the fall of 1871 to take charge of his father's farm, which he worked upon shares, lumbering in winter and performing the ordinary farm work in the summer. Such was his life for nearly two years, during which time he had been so impressed by reading Winchell's Sketches of Creation, Lyell's Principles of Geology, and other books that he determined to go to college. Accordingly he again attended Cazenovia Seminary during the spring term of 1873, when his unusual facility as a writer and his natural ability as a speaker became manifest for the first time. It should be added that these accomplishments were not entirely natural to young Underwood and were acquired only with very considerable, and to him, painful effort. During this term he represented the Philomathesian Society at the prize declamation contest, delivered his first public oration (this being a chapel exercise at that time), and was also selected as one of the speakers at the commencement exercises, though he was not a member of the graduating class.

The correspondence of this early period shows that the selection of the institution he was to attend was a matter of much concern and that he and his friends discussed the question for a long time, one university being debarred as a "Godless institution." The establishment of Syracuse University near his home, with Alexander Winchell as its first chancellor, decided the matter for him and accordingly in the fall of 1873 he entered this institution, registering in the scientific course.

Here again the surroundings and experiences during his college days make interesting reading. He soon became dissatisfied with the scientific course because deficient in the amount of work required and after seriously considering the advisability of completing the college work in three years, he finally decided to enter the Latin-scientific course although this necessitated the preparation of six books of Virgil, four orations of Cicero, Sallust, Roman History, and Latin Prose. His ability as a speaker again secured for him a place at the Junior Exhibition, an oratorical contest, and also as one of the commencement speakers. His favorite studies were history, mathematics, and geology, the two former by reason of the serious treatment and logical presentation of the subjects and the latter by reason of his natural liking for the biological aspects of the science. This is shown by his devoting ten extra hours per week to this subject during the winter term of his junior or senior years, without credit so far as his college course was concerned. It should be stated that the other sciences offered in the university did not appeal to him strongly, doubtless because they could not be properly presented at that time. This is indicated by the fact that he never enjoyed the use of a microscope during his entire college course save for "one happy afternoon" when he had the rare treat of using a stand and examining a few stock slides that were furnished with microscopes at that time, such as the foot of a fly or the "scales from a butterfly's wing." That he was drawn to the subject in which his life-work finally centered is shown by his starting the compilation of an herbarium in 1875 and, self-instructed, he began a study of the ferns, collecting in Herkimer and other localities specimens which he later characterized as scrappy and of no value. It should be added that he gave a great deal of attention to entomology and perhaps this study appealed to him quite as strongly as any other.

Another feature of his college life not in accord with present day conditions was the absence of the vacation habit. During one summer he attempted canvassing "with negative results" and during two seasons he worked upon farms in the vicinity of Syracuse. In this manner he earned sufficient money in 1876 to enable him to visit New York City and the Centennial Exposition at Philadelphia, thus giving him his first view of the outside world.

At the time of his graduation in 1877 he had made up his mind to enter the teaching profession, but he became so discouraged over his failure to secure a position that he seriously meditated entering other lines of work. He finally secured the principalship of the Morrisville Union School at a salary of $700 per year, going on trial at $600 if *not* satisfactory. It would appear as if his experiences at this school would have forever driven any thoughts of teaching from his mind. The school was ungraded and he was obliged to conduct fourteen classes a day. The situation was complicated during the winter session by the entrance of a number of large country boys whose scholastic aim was, according to the light of those days, to break up the school. Nevertheless he succeeded, reduced the course of study to a system, and published the first catalogue and courses of study of the institution. The real nature and strength of the man is well shown at this period. He was evidently undecided and uncertain as to the future, though no records of his views are at hand. But that different fields of activity were appealing to him is evinced by the fact that he not only found time to complete the study of Gray's Anatomy, Dalton's Physiology, and a work on chemistry, practically the first year's work at the Syracuse Medical College, but he also completed a year's graduate work, taking the master's degree at Syracuse University in the spring of 1878. It is also noteworthy that he apparently purchased his first work on ferns (Hooker's Synopsis Filicum) at this time and commenced the accumulation of his valuable fern herbarium.

He was elected teacher of natural science in Cazenovia Seminary for the year 1878–1879 and in July, 1878, published in Case's Botanical Index his first botanical paper. This was a brief note containing a list of 44 ferns (species and varieties) occurring about Syracuse, N. Y., and all but four having been found by him

in that locality. A request was made for exchange of native or foreign specimens. During this year at Cazenovia he was able to complete his graduate work in geology, publishing his thesis in 1879 on "The Geological Formations Crossed by the Syracuse and Chenango Valley Railroad," with a sketch of the hydrography of Onondaga and Madison counties.

The following year he was called to the professorship of natural sciences in Hedding College, Abingdon, Illinois, where in addition to the science work he had a class in English literature; in a letter to a friend he writes that he had a hard time keeping ahead of a junior class, five hours a week, using Deschanel's Physics. His labors closed at this institution in the spring with his taking charge for four weeks of the president's class in Butler's Analogy! It was during this busy period that he conceived the idea and prepared the manuscript for a manual of the ferns of North America.

In 1880 he became professor of geology and botany at the Illinois Wesleyan University, at Bloomington, Illinois, where he remained three years. This was a period of unusual activity, as well as one of great diversity of interests. He experienced, so it seemed to him then, the greatest ambition of his life — the publication of his manuscript on the ferns. This work appeared in 1881 as a small octavo volume of 116 pages, containing a description of 147 species, under the title of "Our Native Ferns and How to Study Them." The edition was limited to 400 copies and was sold out within the year. A second edition ("Our Native Ferns and Their Allies") was published the following year, the larger portion of it being subsequently destroyed by fire, and the third edition was entrusted in 1888 to Henry Holt and Company, who issued the sixth revised edition in 1900.

It was during this period that he became interested in the Hepaticae and began the accumulation of the literature on the group. He also had access to Austin's Hepaticae Boreali-Americanae Exiccatae at the Illinois State Laboratory of Natural History, one mile distant from the university. He soon conceived the idea of publishing a manual of the group on the plan of his work on ferns and from the sources above mentioned a catalogue of the Hepaticae was compiled and published in 1884 in the Bulletin of the Illinois State Laboratory of Natural History under the

title, "Descriptive Catalogue of the North American Hepaticae North of Mexico." This interest in the hepatics continued until 1899 and resulted in the accumulation of a valuable herbarium and library and in the production of over a score of papers. Notable among his contributions in this line are the "Hepaticae Americanae," a series of exsiccatae, issued in part jointly with O. F. Cook, the last decades appearing in 1899 as Nos. XIX–XX. He prepared the text on the Hepaticae for Gray's Manual of Botany, sixth edition, published in 1890, and had also formulated plans for an extended systematic presentation of the North American Hepaticae. Only the first part of this work was ever completed, appearing in June, 1893, as one of the Memoirs of the Torrey Botanical Club (Vol. 4, No. 1), under the title, "Index Hepaticarum, Part I, Bibliography."

He was often joined in his collecting trips about Bloomington by Professor Forbes and his associates at the State Laboratory and from this source arose his renewed interest in the arthropods; especially was he attracted to the study of the spiders and crustaceans. The extent of this interest is shown by the fact that at the time when he left zoölogical work in 1890 he had accumulated entomological literature that was quite extensive and had published several preliminary papers, mostly bibliographical, on the Arachnida, Myriapoda, and Crustacea.

The marked ability of Professor Underwood to enlist the interests and secure the coöperation of others is strikingly illustrated during his stay at Bloomington. His field work had taken him to various sections of the state and brought him in contact with men interested in scientific work. Mention might be made of Burrill, Seymour, Forbes, Webster, and others. Largely through these associations the organization of the Indiana Academy of Sciences was effected in 1885. He took an active part in the early history of the society, being one of the promoters of the organization and one of the first directors of the biological survey of the state.

In 1883 he was called to Syracuse University as instructor in geology, zoölogy, and botany, and three years later was made professor. During the seven years of his service at Syracuse we find his labor and interest no less diversified than at Bloomington.

In addition to the subjects mentioned above, he taught analytical chemistry, mathematics for three years, and during the last year of his service, human physiology. He always had a great liking for this subject and frequently referred to this freshman class as the most interesting, enthusiastic, and enjoyable class of his experience. This appears the more interesting in connection with an extract from a letter in which he states, "I have a class of eighty-seven students in a room that will seat fifty fairly well. Ventilation is a difficulty and the period extends from twelve to one, after some of the class have had continuous work since 7:45 A. M."

During his stay at Syracuse he succeeded in introducing laboratory work in biology as a required subject, although this was limited to a two-hour course in the spring term of the second year — such was the opposition to innovations of this nature. Owing to limited facilities for work, it was necessary to divide this class into sections, which often necessitated the repetition of the work on four successive afternoons. This period marks the turning point in his career. Gradually he abandoned the study of zoölogy and discontinued the accumulation of works upon the Arthropoda, on which group, at that time, he had an extensive working library. Henceforth he gave his attention to cryptogamic botany, continuing his work on the hepatics and becoming interested in the mosses and especially in the fungi.

His herbaria of the lower plants increased rapidly, owing to his extensive collecting and especially through exchanges which were made possible by reason of his numerous visits to centers of botanical interest. Thus in 1884 he visited Asa Gray at Cambridge, and he often enthusiastically referred to the assistance received and the friendships formed at the various meetings of the American Association for the Advancement of Science, notably at the Philadelphia meeting in 1884, where he first met many botanists that he had known by correspondence; and at the Ann Arbor meeting in 1885, where he roomed in a private house with Arthur, Barnes, and Coulter, while they were making the final review of their "Handbook of Plant Dissection." He spent the summer of 1887 in Georgia, Tennessee, and Virginia, in the service of the Smithsonian Institution, and during the following summer he was occupied in collecting, largely in southern California.

The results of the labor of these years appears in several papers upon the Hepaticae, ferns, and fern allies, while his growing interest in the fungi is indicated by the appearance in 1889 (under joint authorship with O. F. Cook) of "A Century of Illustrative Fungi" and his "Generic Synopses of the Basidiomycetes and Myxomycetes." Both of these works were designed to enable the beginner to become somewhat familiar with the fungi, the first work being a collection of one hundred of our more common species put up in book form.

Securing a year's leave of absence in 1890, he accepted a Morgan fellowship at Harvard University for the purpose of studying the Sullivant and Taylor collections of hepatics and he also had in mind a revision of the Polyporaceae, in which group he had been working for several years. This work was interrupted early in 1891 by his undertaking for the Department of Agriculture a study of the extent and distribution of the orange disease in Florida. This investigation enabled him to make large collections in many sections of Florida and he also made an excursion into Cuba, in the hope of securing extensive collections of ferns. Returning north in April, he collected at several stations in Georgia and resumed his work at the Gray Herbarium.

While at Cambridge he accepted a professorship of botany at De Pauw University, Greencastle, Indiana. This was the first time in his career that he had the opportunity to direct his attention to botany alone, and it is noteworthy that he accepted this position at a lower salary than he was receiving and also at the same time declined a more remunerative position in another institution in order to specialize more closely. There now followed a period of work under the most congenial surroundings and during these four years he published numerous papers on the lower groups of plants. He was a member of the original committee on nomenclature at the Rochester meeting of the American Association in 1892 and was selected as the delegate to carry the report of the American botanists on this question to the International Botanical Congress in Genoa. He was one of the vice-presidents of the Genoa Congress and took part in the discussion which resulted in fixing 1753 as the date of commencing botanical nomenclature. He was greatly influenced by this visit to the Continent, and took

advantage of the opportunity to examine the famous herbaria and become acquainted with the botanical leaders in his line of study, such as Prantl, Strasburger, Ascherson, Magnus, Ward, Chodat, Saccardo, De-Toni, Baillon, and others. The interest thus aroused led him repeatedly to visit England and the Continent, in all making eight trips for the purpose of comparison and study at various botanical centers.

He had for a long time contemplated the preparation of a work on the cryptogamic flora of North America modeled somewhat on the pattern of Rabenhorst's Kryptogamen-Flora, but his views broadened as a result of his continental experiences, and early in 1893 he wrote a letter to Professor Britton proposing the formation of a body to organize a general descriptive work on the flora of North America. This resulted in the creation of a standing board of editors of the "Systematic Botany of North America," which was subsequently transferred to Underwood and Britton under the new title, "North American Flora," to be published by the New York Botanical Garden. He served as vice-president of the Botanical Section of the American Association at the New York meeting in 1894.

Owing to financial difficulties at De Pauw, the department of botany was temporarily abolished in 1895, when he accepted a position as professor of biology in the Alabama Polytechnic Institute. He was interested chiefly in fungi during this stay at Auburn and made extensive collecting trips in several of the southern states. Several papers were published upon the fungi, dealing chiefly with their economic importance. Owing to the difficulty of approaching the study of these plants, he began the collection of the extensive and scattered literature of the subject with a view to preparing a work that would serve as an introduction to the study of the group. Later, this material was put into form and appeared in 1899 as a volume entitled "Moulds, Mildews, and Mushrooms." During this period he completed the text on the Pteridophyta for Britton and Brown's Illustrated Flora.

After one year at Auburn he became professor of botany in Columbia University in July, 1896. Up to this period his life had indeed been a varied one, but it is not to be inferred that this was due to any uncertainty of purpose or lack of perception. Three

times he had accepted less remunerative positions in order to confine his work more closely to the lower forms of plant life and now for the first time he had the opportunity of realizing the ambition of his life. His interest now became more and more centered in the ferns and he enthusiastically devoted all his energies to studying and amassing collections of these plants. This work necessitated extended collecting trips in the United States and in the West Indies as well as repeated visits to the herbaria of Europe for comparison and study of material.

His career at Columbia has been attended by signal honor. He was one of the ten botanists elected at the Madison meeting of the American Association to form the Botanical Society of America, of which organization he served as president in 1899–1900. He became editor of the publications of the Torrey Botanical Club in 1898 and acted in this capacity until the end of 1902. He was associate editor of "North American Flora" from the beginning of his work at Columbia, during which period five parts have appeared. He was a member of the board of Scientific Directors of the New York Botanical Garden and since 1901 was the chairman of this board. In 1906 Syracuse University recognized his long and eminent service by conferring upon him the degree of doctor of laws.

His work at Columbia has been most fruitful and far-reaching in its results. The publication of his manuscript on "Moulds, Mildews, and Mushrooms" in 1899 stimulated study along this line and assisted greatly in establishing mycological clubs in many sections of the country. His numerous papers on the Pteridophyta and the recent revisions of his book upon "Our Native Ferns and Their Allies" have presented a rational system of classification of the group and a conception of its relationships and of the problems to be considered in its study that will serve as a guide in the investigation of these plants for generations to come.

In reviewing this brief account of Professor Underwood's life and his varied activities we are impressed with the traits that actuated and controlled him. He inherited an energy and a keenness of interest, a curiosity and a quickness of perception regarding living things that are the endowment of few. These characteristics led him irresistibly to the study of natural history and explain the

enthusiasm with which he pursued the various lines of his life-work. To him the keenest pleasure and the best recreation was life in the field, whether the exploration led him in quest of new forms of life or to a reëxamination of familar types. He had an intense ambition to accomplish work. To us this was the dominant trait of his character. His, however, was not an ambition to excel or gain recognition, not a desire for reputation or notoriety, but an impulse to add to the sum of human knowledge and a broadening of the understanding. And to this work he brought that rare quality of arousing interest where none existed, so that his labor is not finished but has been handed to others — his students, his friends. His work has been essentially that of a pioneer. He has blazed the trails and prepared the roads that others may follow and continue the work to greater advantage.

In this estimate of the man we must not overlook other traits of his personality. To all he was the light-hearted, genial associate, but to those in need of assistance he was the sympathetic and helpful friend; and to such his energies were given with an unselfishness that remains as the most cherished memory of the man to so many. The simplicity of his nature, the genuineness of his interest, and his desire to share and to help constitute the charm of a personality that drew people to him and made them his friends.

These higher traits of his nature stand out supreme in his home life. In August, 1881, he married Miss Marie A. Spurr and thenceforth the home was the one place around which all other interests centered. The love of wife and daughter, the sympathies and the enjoyments of the home, was the one theme towards which his thoughts ever drifted. Among his treasured papers, and there are so many of these, is one, in his wife's handwriting, pocket-worn almost past the point of legibility. No better insight into the nature of the man can be given than to repeat a few stanzas of this manuscript:

"Sweet home upon the hillside fair,
Wherever I may roam,
Through southern grove or western wild,
Thou'rt yet my cherished home.
Thy portals wide
For me still hide
The dearest earthly room

"Above the city's noise and strife
Oft has my soul found rest,
As to the weary work-dimmed eye
Thou gavest visions blest.
On land or sea
I turn to thee
As worn bird to her nest.

"Thence have I marked the seasons tread
Their stately solemn round;
Thence have I watched the Storm-King's flight
On angry mission bound.
In winter drear
Or summer's cheer
Thou'rt ever hallowed ground.

"How have I loved at eve to pause
And scan the western sky,
What time the sun with affluence flung
His crimson banners high.
A promise fair
Of days more rare
When life's last night draws nigh.

"Above thy gabled roofs
The heavens bend more low;
The ceaseless tides of human life
Below thee ebb and flow.
Within thy walls
Love's gentle calls
Make Paradise below."

Our friend rests in a place which almost seems to have been designed by nature for him, on a hillside in the little rural cemetery of Umpawaug at Redding, bordered by two fern-banked streams babbling down to the near-by glen of the Saugatuck, through which he so much loved to take his friends.

Lucien Marcus Underwood: a memorial tribute*

MARSHALL AVERY HOWE

An appreciation of the character and work of Lucien M. Underwood that shall be wholly impartial and dispassionate can hardly be expected of those who were intimately associated with him during a considerable number of the most productive years of his life. Yet those, more than others, knew the man as he was and as he worked, and they are for that reason entitled to a hearing. It was my privilege to begin a correspondence with him in 1892 at a time when I was making the acquaintance of some of the Californian Hepaticae in the field and was trying to learn something of their published history without the advantage of access to much of the pertinent literature. Professor Underwood had then for ten years been accumulating Hepaticae and the literature relating to this group of plants, had published his "Descriptive Catalogue of North American Hepaticae, North of Mexico" and his elaboration of the group in the sixth edition of Gray's Manual, and was the acknowledged American leader in this line of taxonomic research. The ferns and their allies, knowledge of which, also, he had been efficient in popularizing, were likewise submitted to him, and his generous and helpful responses did much to foster and stimulate my interest, as they did that of many others. In the autumn of 1896 he assumed the duties of the professorship of botany in Columbia University, and my more intimate personal association with him began at that time, for he then offered me an opportunity to continue my studies of the Californian Hepaticae in New York and most generously and encouragingly placed at my service not only his extensive library and herbarium but also the results of his wide experience. In this connection, and in acknowledging my lasting gratitude to Professor Underwood, I am constrained to remark that the breadth of a man's mind and the purity of his desire for the truth is often best indicated in his attitude toward opinions and beliefs which may chance to differ

* Read at a memorial meeting of the Torrey Botanical Club, January 29, 1908.

from his own. In studying the Hepaticae of California it happened in a few instances that I reached conclusions more or less at variance with views to which he had previously given expression in print, as indeed may be expected at any time as a matter of personal equation between any two investigators in the biologic sciences. In such cases, Professor Underwood was always manifestly without bias or prejudice, desiring only the whole truth and confident that the truth alone would ultimately prevail. In fact, his breadth of view and the comprehensiveness of his sympathies were characteristics which impressed themselves upon even casual acquaintances. His work as a teacher of college students was not confined to exclusively botanical lines until he had reached nearly middle age. In his earlier manhood he not only taught geology, zoölogy and chemistry, in addition to botany, but also published several papers dealing with geological, zoölogical, and biological subjects. And his personal acquaintance with plants was remarkably wide even outside of the ferns, the Hepaticae, and the fungi, the groups in which he found his special fields for research. Accordingly, his outlook upon botanical science as a whole had a breadth and sanity that is all too rare in the men that have been schooled in an age of more extreme specialization.

Any just estimate of the scientific work of Professor Underwood cannot fail to emphasize its influence in popularizing botanical knowledge and in rendering it more accessible. Sufficient evidence of the importance of this phase of his work is found in the fact that his "Our Native Ferns and their Allies," with slight variation in title, passed through six editions from 1881 to 1900. This little book was essentially a pioneer in its field, was admirably conceived and charmingly written, and it cannot be an exaggeration to assert that it has done more to stimulate and popularize the study of the American ferns than has any other single agency. The "Descriptive Catalogue of the North American Hepaticae" was likewise a pioneer in its line. It brought together in a convenient form information that had previously been very difficult of access to the ordinary student. It, unhappily, was never reprinted, but that it met a real demand is evidenced by the difficulty with which even second-hand copies were obtainable within a few years after its publication. His "Moulds, Mildews, and Mushrooms,"

published in 1899, was written in a somewhat popular vein as an introduction to the study of the fungi and has served a useful purpose.

In considering the more technical aspects of Professor Underwood's botanical work, one is impressed by his instincts for collecting and systematizing, by his ability to express results in a terse, vigorous, synoptical form, and by the importance which he attached to the study of living plants in their natural surroundings as distinguished from the study of their mummified remains in herbaria. In addition to numerous excursions of a more local nature, he made visits to Florida, California, Porto Rico, Jamaica, and Cuba, for the purpose of making collections and field-studies of the Hepaticae and Pteridophyta. The desirability or even the necessity of such a first-hand acquaintance with the living plants in order to gain any adequate notion of their affinities is sufficiently apparent nowadays as regards any particular group, but is perhaps especially obvious in connection with the tropical tree-ferns, species of which, in some cases, have unfortunately been described from small fragments of the dried leaves. As complementary to the study of living plants in their own homes and to the study of herbarium specimens and the literature pertaining to them, Professor Underwood insisted upon the importance of seeing, if possible, the original or taxonomic "type"-specimen whenever the first description left any reasonable doubt as to the identity of the plant.

In his several visits to Europe, he had seen and examined the materials from which most of the endemic American species of ferns were originally described, in so far as such materials are preserved, and also many foreign types with which American specimens had been identified — sometimes erroneously — by the earlier writers. The results of these comparisons have in part been incorporated in his published papers and in part they will become available to his successors through his unpublished notes and sketches. Professor Underwood's enthusiasm for the correct interpretation of all proposed genera and species was naturally correlated with an interest in other questions connected with the nomenclature of plants. His views in such matters were pronounced; they were forcefully advocated and warmly defended. In the ranks of the reformers and restorers, he was one of the most radical and most logical, one of the least compromising and

least temporizing. Fifty years hence, perhaps, it will be generally conceded that he rendered a notable service to botanical science in insisting upon the importance of nomenclatural types for genera and species, upon the importance of anchoring a specific name to a certain definite specimen by which the validity of the species is to be judged, and upon the importance, in like manner, of pinning a generic name down to a certain definite species, to prevent the endless wandering and shifting which have found such portentous beginnings during the past two centuries. He saw clearly the futility of action like that of a recent International Botanical Congress in decreeing that certain generic names shall be "conserved" without taking the trouble to specify for what they shall be conserved. But names and their correct application, important as he considered them, were after all incidental details in the accomplishment of his main purposes. It was for many years his ambitious hope to assist in the publication of a descriptive flora of North America that should include all the known plants from the lowest to the highest, with the entire continent and the West Indian islands as its field. That he took a leading part in planning such a work he would doubtless consider the crowning effort of his life. That he lived to see the actual publication of five parts of a projected work of such a scope is a source of gratification to his friends.

Lucien M. Underwood was devoted to the world of plants, but he was more devoted to the world of human beings. Nothing human was foreign to him. He loved the beautiful in literature and art as well as the beautiful in the exterior world. His intimates will not soon forget the sympathetic fervor with which he could read selected passages from Victor Hugo's Les Misérables or from a treasured Life of Abraham Lincoln, or the delicacy with which he could describe his emotions on first beholding the Lion of Lucerne. His pupils will not soon forget the hours that he cheerfully gave to their assistance or the personal interest that he felt in their welfare. His friends will not soon forget his generosity, his forbearance, his sympathy, or his loyalty. Lucien M. Underwood might have been a farmer, he might have been an actor, he might have been a physician, he might have been a preacher; but, he was a botanist and a human human-being — and botany and humanity are the richer.

The published work of Lucien Marcus Underwood*

John Hendley Barnhart

The accompanying list of Professor Underwood's publications comprises 212 entries. Nearly two hundred of these relate directly to botanical topics, and it is noteworthy that his first two papers, like his last three, dealt with ferns, and more than one third of the entire number were devoted to the Pteridophyta. The entries may be classified according to subject as follows:

Botanical:	
Pteridophyta	78
Hepaticae	31
Fungi	29
Reviews	17
Miscellaneous	43
Non-botanical:	
Zoölogy	7
Genealogy	2
Geology	1
Miscellaneous	4
Total	212

The various papers and sets of exsiccatae are listed as nearly as possible in chronological order, and nearly all of them have been examined while this bibliography has been in course of preparation. It would be rash to assert that the list is complete, but it is hoped that it approximates completeness. It should be explained, however, that no attempt has been made to include contributions to newspapers, of which it is believed that there were many.

During the years 1898–1902, Professor Underwood was editor-in-chief of the Torrey Botanical Club, and as such edited volumes 25–29 of the Bulletin and a part of volume 6 and all of volumes 7–12 of the Memoirs. The last two numbers of volume 12 of the Memoirs were not published until 1906 and 1907, but Professor Underwood, at the request of his successor, saw them through the press, and his name appears as editor upon the title-page of the

* Presented at a memorial meeting of the Torrey Botanical Club, January 29, 1908.

volume. As editor of the Bulletin, he supervised the preparation of the Index to recent literature relating to American botany, published in monthly instalments throughout the term of his editorship. He did not, however, do all of the work of preparation of material for the Index.

Professor Underwood left no considerable amount of unpublished manuscript in a sufficiently advanced state to make it likely that it will be published posthumously. A portion of his manuscript of the Pteridophyta for the North American Flora can be utilized in the forthcoming numbers of that work, in the establishment of which he held such an important place and in the progress of which he took such a lively interest. He had also nearly ready for publication a genealogy of the Underwood families of America, which he had hoped to see through the press during the present winter of 1907–1908. It is much to be desired that some way may be found of issuing this work in accordance with his wishes.

1878

1. List of ferns growing in the vicinity of Syracuse, Onondaga Co., N. Y. Case's Bot. Index 1 : 80. Jl 1878.
2. *Aspidium marginale* Swartz. Bull. Torrey Club 6 : 266. O 1878.

1879

3. The geological formations crossed by the Syracuse and Chenango Valley Railroad: 18 pages. Syracuse, N. Y., [Jl] 1879.
   Thesis for the degree of doctor of philosophy.

1880

4. Artificial synopses. Bull. Torrey Club 7 : 86–89. Au 1880.

1881

5. Our native ferns and how to study them. 116 pages, *illust.* Bloomington, Ill., 1881.
6. Check list of North American Pteridophyta, excluding the orders Filices and Ophioglossaceae.
   Not seen; mentioned in Bot. Gaz. 6 : 192. Ap 1881.
7. The ferns of New York state. Bull. Torrey Club 8 : 78, 79. Jl 1881.
8. Systematic plant record. Bloomington, Ill., 1881.
   Afterward published by C. W. Bardeen, Syracuse, N. Y.
9. *Onoclea sensibilis* L. var. *obtusilobata* Torr. Bull. Torrey Club 8 : 101, 102. S 1881.

1882

10. North American Hepaticae. Bot. Gaz. **7**: 18–21. F 1882.
Also as a separate.

11. Our native ferns and their allies, with synoptical descriptions of the American Pteridophyta north of Mexico. A second and enlarged edition of Our native ferns and how to study them. 134 pages, *illust.* Bloomington, Ill., [Je] 1882.
The stock of this edition remaining unsold in 1886 was destroyed by fire in a Chicago bindery (see Bot. Gaz. **12**: 23).

12. *Equisetum variegatum.* Bot. Gaz. **7**: 76. Je 1882.

1884

13. The Pteridophyta of Litchfield Co., Ct. Bull. Torrey Club **11**: 7, 8. Ja 1884.

14. Schweinitz and American Hepaticae. Bot. Gaz. **9**: 63. Ap 1884.

15. A brief notice of the Underwood families of Massachusetts. New Engl. Hist. & Geneal. Reg. **38**: 400–405. O 1884.
Also as a repaged separate: The Underwood families of Massachuseetts. 8 pages.

16. Descriptive catalogue of the North American Hepaticae, north of Mexico. Bull. Illinois State Lab. Nat. Hist. **2**: 1–133. O 1884.
Also as a separate.

1885

17. A preliminary list of the Arthrogastra of North America (excluding Mexico). Can. Entom. **17**: 162–169. S 1885.
Also as a repaged separate, 8 pages.

18. The North American Myriapoda. Entom. Am. **1**: 141–151. N 1885.

1886

19. (With HERBERT OSBORN.) Preliminary list of the species of Acarina of North America. Can. Entom. **18**: 4–12. Ja 1886.
Also as a repaged separate, 8 pages.

20. List of the described species of fresh water Crustacea from America, north of Mexico. Bull. Ill. State Lab. Nat. Hist. **2**: 323–386. [O] 1886.

1887

21. Alumni record of Syracuse University, 1872–1886. xii + 368 pages. Syracuse, N. Y., Ja 1887.
Editor of the entire work; contributor of: Annals of Syracuse University, pages 9–30.

22. (With ORATOR FULLER COOK.) Notes on the American species of *Marsilia*. Bull. Torrey Club **14**: 89–94. My 1887.
Also as a separate.

23. The Scolopendridae of the United States. Entom. Am. **3**: 61–65. Jl 1887.

24. The progress of arachnology in America. Am. Nat. **21**: 963–975. N 1887.
Also as a separate.

25. (With ORATOR FULLER COOK.) Hepaticae americanae; decades I–II (nos. 1–20). N 1887.
Exsiccatae; 40 sets.

1888

26. The fern allies. Bot. Gaz. **13**: 22, 23. Ja 1888.
A review of Baker's Hand-book of the fern-allies.

27. The distribution of *Isoetes*. Bot. Gaz. **13**: 89–94. Ap 1888.
Also as a separate.

28. Our native ferns and their allies, with synoptical descriptions of the American Pteridophyta north of Mexico. Third edition, revised. xii + 156 pages, *illust.* New York, 1888.

29. Some undescribed Hepaticae from California. Bot. Gaz. **13**: 112–114. *pl. 3–6.* My 1888.
Also as a separate.

30. The clover rust. Bot. Gaz. **13**: 301, 302. N 1888.

31. (With ORATOR FULLER COOK.) Hepaticae americanáe; decades III–IV (nos. 21–40). N 1888.
Exsiccatae; 40 sets.

1889

32. [Review of] The development of *Pilularia globulifera* L. By D. H. Campbell. Bull. Torrey Club **16**: 138. 8 My 1889.

33. Notes on our Hepaticae — I. Northern species. Bot. Gaz. **14**: 191–198. Au 1889.
Also as a separate.

34. (With ORATOR FULLER COOK.) A century of illustrative fungi, with generic synopses of the Basidiomycetes and Myxomycetes. 21 pages. Syracuse, N. Y., S 1889.
Text, with accompanying exsiccatae (nos. 1–100).
The same text was issued separately under the title: Generic synopses of the Basidiomycetes and Myxomycetes. 21 pages. [Syracuse, N. Y., S 1889.]

35. (With ORATOR FULLER COOK.) Hepaticae americanae; decades V–VI (nos. 41–60). N 1889.
Exsiccatae; 40 sets.

1890

36. Hepaticae. In: GRAY, ASA. Manual of the botany of the northern United States, sixth edition, 702–732. *pl. 22–25.* New York, 1890.

37. (With ORATOR FULLER COOK.) Hepaticae americanae; decades VII–VIII (nos. 61–80). My 1890.
Exsiccatae; 40 sets.

38. A notable collection of botanists. Bull. Torrey Club 17: 154, 155. 9 Je 1890.

39. Notes on the heterosporous fern allies of the Pacific coast and Mexico. Zoe 1: 97–101. Je 1890.
Also as a separate.

40. A new North American *Lejeunea*. Bull. Torrey Club 17: 258 259. 9 O 1890.

1891

41. A preliminary list of Pacific coast Hepaticae. Zoe 1: 361–367. F 1891.
Also as a separate.

42. (With ORATOR FULLER COOK.) Hepaticae americanae; decades IX–X (nos. 81–100). My 1891.
Exsiccatae; 40 sets.

43. (With ORATOR FULLER COOK.) List of mosses collected by T. S. Brandegee in the Yakima region of Washington, 1882–3. Zoe 2: 107, 108. Jl 1891.

44. The distribution of Hepaticae of North America. Proc. Am. Assoc. Adv. Sci. 39: 298–304. Jl 1891.
Also as a separate.

45. The ancestry and descendants of Jonathan Pollard (1759–1821), with records of allied families. 20 pages. Syracuse, N. Y., 1891.
Two hundred copies, privately printed.

46. Diseases of the orange in Florida. Jour. Myc. 7: 27–36. 10 S 1891.

47. A flora of Texas. Bot. Gaz. 16: 268, 269. S 1891.
A review of Coulter's Manual of the phanerogams and pteridophytes of western Texas.

48. (With ORATOR FULLER COOK.) Hepaticae americanae; decades XI–XII (nos. 101–120). D 1891.
Exsiccatae; 40 sets.

1892

49. (With ORATOR FULLER COOK.) Hepaticae americanae; decades XIII–XIV (nos. 121–140). My 1892.
Exsiccatae; 40 sets.

50. Recent work in systematic hepaticology. Bot. Gaz. 17: 218–220. Jl 1892.

51. Connecting forms among polyporoid fungi. Zoe **3**: 91–95. Jl 1892.

52. Some points in the nomenclature-priority question. Science **20**: 116, 117. 26 Au 1892.

53. The Hepaticae of Labrador. Bull. Torrey Club **19**: 269, 270. 10 S 1892.
Also as a separate.

54. A variety of *Polypodium vulgare* L., new to America. [Abstract.] Bull. Torrey Club **19**: 283, 284. 10 S 1892.
A correction. Bull. Torrey Club **20**: 21. 15 Ja 1893.

55. A few additions to the hepatic flora of the Manual region. Bull. Torrey Club **19**: 299–301. 10 O 1892.
Also as a separate.

56. A preliminary comparison of the hepatic flora of boreal and subboreal regions. Bot. Gaz. **17**: 305–312. O 1892.
Abstract in Proc. Am. Assoc. Adv. Sci. **41**: 219, 220. D 1892.

57. The nomenclature question at Genoa. Bull. Torrey Club **19**: 325–330. 15 N 1892.
Also as a separate.

58. The international congress at Genoa. Bot. Gaz. **17**: 341–347. N 1892.
Also as a separate.

59. The distribution of tropical ferns in peninsular Florida. Proc. Indiana Acad. Sci. **1891**: 83–89. 1892.
Also in a separate of pages 83–91 (this paper and the following).

60. Some additions to the state flora [of Indiana] from Putnam County. Proc. Indiana Acad. Sci. **1891**: 89–91. 1892.
Also in a separate of pages 83–91 (this paper and the preceding).

61. Carl Moritz Gottsche. Bot. Gaz. **17**: 417, 418. D 1892.

62. The botanical congress. Bot. Gaz. **17**: 425, 426. D 1892.

1893

63. The dissipation of energy in college education. Addresses Indiana Coll. Assoc. **1892**: 30–46. 1893.

64. [Address before the Genoa Botanical Congress.] Atti Congr. Bot. Internaz. Genova 113–116. 1893.

65. (With ORATOR FULLER COOK.) Hepaticae americanae; decades XV–XVI (nos. 141–160). My 1893.
Exsiccatae; 40 sets.

66. Index Hepaticarum. Part I. — Bibliography. Mem. Torrey Club **4**: 1–91. 10 Je 1893.
Constituting Mem. Torrey Club, vol. 4, no. 1.

67. Our native ferns and their allies, with synoptical descriptions of the American Pteridophyta north of Mexico. Fourth edition, revised. xii + 156 pages, *illust.* New York, 1893.

68. A review of the literature of the North American Myriapoda. Bull. U. S. Nat. Mus. **46**: 9–17. [N] 1893.
Also editor of the entire Bulletin: BOLLMAN, CHARLES HARVEY. The Myriapoda of North America.

69. Pteridophyta. Mem. Torrey Club **5**: 9–17. 4 D 1893.
Forming part of the List of Pteridophyta and Spermatophyta growing without cultivation in northeastern North America, prepared by a Committee of the Botanical Club, American Association for the Advancement of Science.
The entire List was also issued as a separate.

1894

70. A fern-book offer. Linnaean Fern Bull. **1**[3]: 6. Ja 1894.

71. Pteridophyta. In: COULTER, JOHN MERLE. Botany of western Texas (Contr. U. S. Nat. Herb. **2**:) 557–568. 10 My 1894.

72. A new *Selaginella* from Mexico. Bull. Torrey Club **21**: 268, 269. 20 Je 1894.

73. Notes on our Hepaticae — II. The genus *Riccia*. Bot. Gaz. **19**: 273–278. Jl 1894.
Also as a separate.

74. Report of the botanical division of the Indiana State Biological Survey. Proc. Indiana Acad. Sci. **1893**: 13–67. Au 1894.
The actual report occupies pages 13–19; Appendix A, Bibliography of Indiana botany, pages 20–30; Appendix B, List of cryptogams at present known to inhabit the state of Indiana, pages 30–67.
Also as a separate.

75. Our present knowledge of the distribution of pteridophytes in Indiana. Proc. Indiana Acad. Sci. **1893**: 254–258. Au 1894.

76. The evolution of the Hepaticae. Bot. Gaz. **19**: 347–361, *illust.* 15 S 1894.
Vice-presidential address before Section G, A.A.A.S.
Also as a separate.
Also in Proc. Am. Assoc. Adv. Sci. **43**: 259–274, *illust.* Mr 1895.
Also as a separate, "1894" [1895].

77. Edible fungi — a great waste of vegetable food in Indiana. Trans. Indiana Hort. Soc. **1893**: 62–67. *pl.* 1894.
Also as a repaged separate, 8 pages.

78. Indiana flora. Distributed by the Biological Survey. Series I (1–100), Parasitic fungi. D 1894.
Exsiccatae; 20 sets.

1895

79. Hepaticae. 7 pages. [New York,] Ja 1895.

This was a prospectus (containing only one genus, *Riccia*) of a work to be entitled "Systematic botany of North America." The publication of the work was not actually commenced until ten years later, and then under the changed title "North American flora."

80. Notes on our Hepaticae — III. The distribution of our North American Marchantiaceae. Bot. Gaz. **20**: 59–71. 16 F 1895.
Also as a separate.

81. The relations of the red cedar to our orchards. Trans. Indiana Hort. Soc. **1894**: 81–84. 1895.

82. The classification of the archegoniates. Bull. Torrey Club **22**: 124–129. 27 Mr 1895.
Also as a separate.

83. An interesting *Equisetum*. Bot. Gaz. **20**: 326. 15 Jl 1895.

84. An increasing pear disease in Indiana. (Abstract.) Proc. Indiana Acad. Sci. **1894**: 67. O 1895.

85. The variations of *Polyporus lucidus*. (Abstract.) Proc. Indiana Acad. Sci. **1894**: 132, 133. O 1895.

86. The proposed new systematic botany of North America. (Abstract.) Proc. Indiana Acad. Sci. **1894**: 133. O 1895.

87. Report of the botanical division of the Indiana State Biological Survey for 1894. Proc. Indiana Acad. Sci. **1894**: 144–156. O 1895.

The actual report occupies pages 144–147; Appendix A, List of additions to the state flora, pages 147–153; Appendix B, Additional list of host plants of fungi, 1894, pages 153, 154; Appendix C, Notes on the species reported previously, page 154; Appendix D, List of parasitic fungi distributed by the Indiana Biological Survey, December, 1894, series 1, no. 1–100, pages 154–156.

1896

88. [Review of] The structure and development of mosses and ferns. By Douglas Houghton Campbell. Science **II.** 3: 70, 71. 10 Ja 1896.

89. Notes on our Hepaticae — IV. The genus *Fossombronia*. Bot. Gaz. **21**: 67–71. 18 F 1896.
Also as a separate.

90. (With FRANKLIN SUMNER EARLE.) Treatment of some fungous diseases. Bull. Ala. Agr. Exp. Sta. no. 69 (4: 243–272). F 1896.

91. On the distribution of North American Helvellales. Minn. Bot. Studies **1**: 483–500. 30 Ap 1896.
Also as a separate, in advance, 10 Mr 1896.

92. Our native ferns and their allies, with synoptical descriptions of the American Pteridophyta north of Mexico. Fifth edition, revised. xii + 156 pages, *illust.* New York, 1896.

93. (With ORATOR FULLER COOK.) Hepaticae americanae; decades XVII–XVIII (nos. 161–180). Ap 1896.
Exsiccatae; 40 sets.

94. Mycology in the southern states. Gard. & For. **9**: 263, 264. 1 Jl 1896.

95. Pteridophyta. In: BRITTON, NATHANIEL LORD, & BROWN, ADDISON. An illustrated flora of the northern United States, Canada, and the British possessions, **1**: 1–48. New York, [Au] 1896.

96. (With FRANKLIN SUMNER EARLE.) The distribution of the species of *Gymnosporangium* in the South. Bot. Gaz. **22**: 255–258. 23 S 1896.
Also as a separate.
Abstract in Science **II. 4**: 437. 25 S 1896.

97. Notes on the allies of the sessile *Trillium*. [Abstract.] Science **II. 4**: 436. 25 S 1896.

98. The genus *Cephalozia* in North America. Bull. Torrey Club **23**: 381–394. 25 O 1896.
Also as a separate: Contr. Dep. Bot. Columbia Univ. no. 101.

99. (With FRANKLIN SUMNER EARLE.) Notes on the pine-inhabiting species of *Peridermium*. Bull. Torrey Club **23**: 400–405. 25 O 1896.
Abstract in Science **II. 4**: 437. 25 S 1896.

100. *Coleosporium Campanulae* (Pers.) Wint. Bull. Torrey Club **23**: 423. 25 O 1896.

101. Edible fungi: a wasted food product. Bull. Ala. Agr. Exp. Sta. no. 73 (**4**: 335–346. *f. 1–3*). O 1896.

102. Flour considered from the standpoint of nutrition. Bull. Ala. Agr. Exp. Sta. no. 74 (**4**: 347–358). O 1896.

103. The habitats of the rarer ferns of Alabama. Bot. Gaz. **22**: 407–413. *pl. 21*. 23 N 1896.
Also as a separate.
Abstract in Science **II. 4**: 436. 25 S 1896.
The final paragraph was reprinted in Fern Bull. (**5**: 63, 64. O 1897) under the title: *Trichomanes Petersii*.

104. Report of Biologist. Ann. Rep. Agr. Exp. Sta. Ala. **8**: 20, 21. 1896.

105. Terminology among the orders of thallophytes. Bull. Torrey Club **23**: 526–532. 29 D 1896.
Also as a separate: Contr. Dep. Bot. Columbia Univ. no. 109.

1897

106. Some new fungi, chiefly from Alabama. Bull. Torrey Club **24**: 81–86. 28 F 1897.
Also as a separate: Contr. Dep. Bot. Columbia Univ. no. 113.

107. Notes on the American Hydnaceae — I. Bull. Torrey Club **24**: 205, 206. 24 Ap 1897.

108. The varieties of *Botrychium ternatum*. Fern Bull. **5**: 28, 29. Ap 1897.

109. [Review of] Laboratory practice for beginners in botany. By William A. Setchell. Science **II. 5**: 735, 736. 7 My 1897.

110. (With FRANKLIN SUMNER EARLE.) A preliminary list of Alabama fungi. Bull. Ala. Agr. Exp. Sta. no. 80 (**5**: 111–284, i–xvii). "Ap" [Je] 1897.
Pages 271–284 are devoted to an appendix: Suggestions to collectors of fleshy fungi (these pages were reprinted in pamphlet form, see no. 112).

111. Species of *Botrychium*. Bot. Gaz. **23**: 464–466. 28 Je 1897.

112. Suggestions to collectors of fleshy fungi. 14 pages. Cambridge, [Mass.,] 1897.
Reprinted from Bull. Ala. Agr. Exp. Sta. no. 80 (see no. 110).

113. The ferns of Scolopendrium Lake. Fern Bull. **5**: 53, 54. O 1897.

114. Additions to the published lists of Indiana cryptogams. Proc. Indiana Acad. Sci. **1896**: 171, 172. [O] 1897.
Also as a repaged separate, 2 pages.

1898

115. *Selaginella rupestris* and its allies. Bull. Torrey Club **25**: 125–133. 19 Mr 1898.
Also as a separate: Contr. Dep. Bot. Columbia Univ. no. 136.

116. The study of botany in high schools. Jour. Pedag. **11**: 181–191. Ap 1898.
Also as a separate: Contr. Dep. Bot. Columbia Univ. no. 144.

117. [Review of] Die Farnkräuter der Erde. By H. Christ. Science **II. 7**: 572–574. 22 Ap 1898.

118. [Review of] Syllabus der Pflanzenfamilien. Zweite, umgearbeitete Ausgabe. Von Dr. Adolph Engler. Science **II. 8**: 136–139. 29 Jl 1898.

119. American ferns — I. The ternate species of *Botrychium*. Bull. Torrey Club **25**: 521–541. 15 O 1898.
Also as a separate: Contr. Dep. Bot. Columbia Univ. no. 150.

120. Two recently named genera of Basidiomycetes. Bull. Torrey Club **25**: 630, 631. 16 D 1898.
Also as a separate.

1899

121. (With ORATOR FULLER COOK.) Hepaticae americanae; decades XIX–XX (nos. 181–200). 1899.
Exsiccatae; 40 sets.

122. American ferns — II. The genus *Phanerophlebia*. Bull. Torrey Club **26**: 205–216. *pl. 359, 360.* 15 My 1899.
Also as a separate: Contr. Dep. Bot. Columbia Univ. no. 156.

123. A new *Cantharellus* from Maine. Bull. Torrey Club **26**: 254, 255. 15 My 1899.

124. The Royal Botanic Gardens at Kew. Science **II. 10**: 65–75. 21 Jl 1899.

125. [Review of] How to know the ferns. By Frances Theodora Parsons. Science **II. 10**: 150. 4 Au 1899.

126. The International Catalogue of Scientific Literature: Report from Columbia University: M. Botany. Science **II. 10**: 171, 172. 11 Au 1899.

127. Moulds, mildews, and mushrooms: a guide to the systematic study of the Fungi and Mycetozoa and their literature. vi + 236 pages. *10 pl.* New York, 1899.

128. Mrs. Arvilla J. Ellis. Bull. Torrey Club **26**: 553. 16 O 1899.

129. *Asplenium ebenoides* — a correction. Fern Bull. **7**: 95, 96. O 1899.

130. A review of the genera of ferns proposed prior to 1832. Mem. Torrey Club **6**: 247–283. 1 D 1899.
Constituting Mem. Torrey Club vol. **6**, no. 4.
Also as a separate.

131. [Review of] The botanists of Philadelphia and their work. By John W. Harshberger. Science **II. 10**: 931, 932. 22 D 1899.

1900

132. [Botany of ferns.] In: BAILEY, LIBERTY HYDE, & MILLER, WILHELM. Cyclopedia of American horticulture, vol. **1.** New York, 14 F 1900:
Signed articles, as follows: *Acrostichum*, 20–22; *Actinopteris*, 23; *Adiantum*, 24–27; *Alsophila*, 53; *Anemia*, 62, 63; *Angiopteris*, 66; *Asplenium*, 110, 111; *Azolla*, 123; *Blechnum*, 166, 167; *Botrychium*, 172; *Callipteris*, 217; *Camptosorus*, 233; *Ceratopteris*, 277; *Cheilanthes*, 289, 290; *Cibotium*, 316; *Cryptogramma*, 405; *Cyathea*, 423, 424; *Cyrtomium*, 439; *Cystopteris*, 440; *Davallia*, 461, 462; *Dennstaedtia*, 472; *Deparia*, 472; *Dicksonia*, 480; *Dictyogramma*, 481; *Didymochlaena*, 481; *Diplazium*, 491; *Doryopteris*, 501; *Drymoglossum*, 507; *Drynaria*, 508; *Dryopteris*, 508, 509.
Reprinted without change in subsequent editions.

133. The Ellis collection of fungi. Jour. N. Y. Bot. Garden 1: 38-40. Mr 1900.

134. (With FRANCIS ERNEST LLOYD.) A review of the species of *Lycopodium* of North America. Bull. Torrey Club 27: 147–168. *pl. 2–4.* 21 Ap 1900.
Also as a separate: Contr. Dep. Bot. Columbia Univ. no. 169.

135. [Botany of ferns.] In: BAILEY, LIBERTY HYDE, & MILLER, WILHELM. Cyclopedia of American horticulture, vol. 2. New York, 18 Jl 1900.
Signed articles, as follows: Fern, 572, 573; *Gleichenia*, 651; *Goniopteris*, 655; *Gymnogramma*, 701; *Hemionitis*, 729; *Hemitelia*, 729; *Humata*, 779, 780; *Hymenophyllum*, 788; *Hypolepis*, 793; *Lastraea*, 887; *Leucostegia*, 908; *Lomaria*, 938, 939; *Loxoscaphe*, 947; *Lycopodium*, 958, 959; *Marattia*, 984; *Matteuccia*, 993; *Meniscium*, 1002; *Microlepia*, 1012; *Mohria*, 1025.
Reprinted without change in subsequent editions.

136. Our native ferns and their allies, with synoptical descriptions of the American Pteridophyta north of Mexico. Sixth edition, revised. x + 158 pages, *illust.* New York, [Jl] 1900.

137. Why *Dryopteris* and not *Lastraea?* Fern Bull. 8: 52–55. Jl 1900.

138. A new *Botrychium* from Jamaica. Fern Bull. 8: 59, 60. Jl 1900.

139. The last quarter — a reminiscence and an outlook. Science II. 12: 161–170. 3 Au 1900.
Address of retiring president, Botanical Society of America.
Also as a reprint, 18 pages: Bot. Soc. Am. Publ. no. 15.

140. The system of ferns proposed in Die natürlichen Pflanzenfamilien. Fernwort Papers Linn. Fern Chapt. 16–19. 20 D 1900.

1901

141. A new *Adiantum* from New Mexico. Bull. Torrey Club 28: 46, 47. 31 Ja 1901.
Also as a separate.

142. Mycophagy and its literature. Torreya 1: 43–46. 19 Ap 1901.

143. [Botany of ferns.] In: BAILEY, LIBERTY HYDE, & MILLER, WILHELM. Cyclopedia of American horticulture, vol. 3. New York, 23 Ap 1901.
Signed articles, as follows: *Nephrodium*, 1075; *Nephrolepis*, 1075, 1076; *Notholaena*, 1096; *Onoclea*, 1140; *Onychium*, 1142; *Ophioglossum*, 1142; *Osmunda*, 1178; *Pellaea*, 1264, 1265; *Phegopteris*, 1296; *Phyllitis*, 1318; *Phymatodes*, 1319, 1320; *Polypodium*, 1394, 1395; *Polystichum*, 1395, 1396; *Pteridium*, 1462, 1463; *Pteris*, 1463, 1464.
Reprinted without change in subsequent editions.

144. Suggestions for the study of the North American Boletaceae. 41 pages. New York, My 1901.
Contr. Dep. Bot. Columbia Univ. no. 176. (This series consists almost entirely of separates, but the present paper appeared in no other form.)

145. The names of our ferns. Bot. Gaz. **31**: 365, 366. 18 My 1901.

146. [*Lycopodium tristachyum*.] Torreya **1**: 58 (footnote). 22 My 1901.

147. An enumeration of the pteridophytes collected by R. S. Williams and J. B. Tarleton [in the Yukon territory]. Bull. N. Y. Bot. Garden **2**: 148, 149. 27 My 1901.

148. A changed conception of species. Fern Bull. **9**: 49–53. Jl 1901.
A correction. Fern Bull. **10**: 27. Ja 1902.

149. Pteridophyta. In: BRITTON, NATHANIEL LORD. Manual of the flora of the northern States and Canada, 1–29. New York, 1901.
Reprinted in the second edition, 1905.

150. Report . . . on a trip to Porto Rico. Jour. N. Y. Bot. Garden **2**: 166–173. N 1901.

151. A popular work on ferns. Torreya **1**: 134, 135. 25 N 1901.
A review of Clute's Our ferns in their haunts.

1902

152. Conservation of energy in mycological clubs. Torreya **2**: 1, 2. 24 Ja 1902.

153. The *Selaginellae* of North America—I. Fern Bull. **10**: 8–12. Ja 1902.

154. [Botany of ferns.] In: BAILEY, LIBERTY HYDE, & MILLER, WILHELM. Cyclopedia of American horticulture, vol. 4. New York, 26 F 1902.
Signed articles, as follows: *Schizaea*, 1625; *Selaginella*, 1647–1650; *Todea*, 1812; *Trichomanes*, 1849; *Vittaria*, 1656; *Woodsia*, 1990; *Woodwardia*, 1990.
Reprinted without change in subsequent editions.

155. American ferns.—III. Our genera of Aspidieae. Bull. Torrey Club **29**: 121–136. 24 Mr 1902.
Also as a separate: Contr. Dep. Bot. Columbia Univ. no. 189.

156. [Review of] Die Farngattung *Niphobolus*. By Professor Giesenhagen. Science **II. 15**: 623, 624. 18 Ap 1902.

157. Report of the Scientific Directors [for 1901]. Bull. N. Y. Bot. Garden **2**: 310–312. 25 Ap 1902.

158. Minor inaccuracies. Fern Bull. **10**: 53, 54. Ap 1902.

159. Fungi, edible and poisonous. In: BUCK, ALBERT HENRY. Reference handbook of the medical sciences, second edition, **4**: 275–286, *illust.* 1902.

160. The bracket fungi. Torreya **2**: 87–90. 12 Je 1902.

161. [Review of] A university text-book of botany. [By D. H. Campbell.] Torreya **2**: 108–111. 1 Jl 1902.

162. (With WILLIAM RALPH MAXON.) Notes on a collection of Cuban Pteridophyta, with descriptions of four new species. Bull. Torrey Club **29**: 577–584. 31 O 1902.
Also as a separate.
Also as a separate: Contr. Dep. Bot. Columbia Univ. no. 195.

163. Some features of future fern study. Fern Bull. **10**: 105–107. "O" [N] 1902.

164. Two new species of *Selaginella* in the southern flora. Torreya **2**: 172, 173. 25 N 1902.
Also as a separate: Contr. Dep. Bot. Columbia Univ. no. 198.

165. American ferns—IV. The genus *Gymnogramme* of the Synopsis Filicum. Bull. Torrey Club **29**: 617–634. 28 N 1902.
Also as a separate: Contr. Dep. Bot. Columbia Univ. no. 196.

166. A question in terminology. Science **II. 16**: 869, 870. 28 N 1902.

167. Some historic trees. Jour. N. Y. Bot. Garden **3**: 213–220. D 1902.

168. American ferns—V. A review of the genus *Danaea*. Bull. Torrey Club **29**: 669–679. 30 D 1902.
Also as a separate: Contr. Dep. Bot. Columbia Univ. no. 199.

1903

169. The gold and silver ferns. [Abstract.] Science **II. 17**: 26, 27. 2 Ja 1903.—Torreya **3**: 12, 13. 26 Ja 1903.

170. A new index to botanical literature. Torreya **2**: 184–186. 8 Ja 1903.
A review of the International catalogue of scientific literature: M. Botany: First issue.

171. An index to the described species of *Botrychium*. Bull. Torrey Club **30**: 42–55. *f. 1–7*. 4 F 1903.
Also as a separate: Contr. Dep. Bot. Columbia Univ. no. 201.

172. Notes on southern ferns. Torreya **3**: 17–19. 19 F 1903.

173. Report of the Scientific Directors [for 1902]. Bull. N. Y. Bot. Garden **2**: 490, 491. 18 Mr 1903.

174. (With MARSHALL AVERY HOWE.) The genus *Riella*, with descriptions of new species from North America and the Canary Islands. Bull. Torrey Club **30**: 214–224. *pl. 11, 12*. 24 Ap 1903.
Also as a separate: Contr. N. Y. Bot. Garden no. 34.

175. The Department of Botany and its relation to the New York Botanical Garden. Columbia Univ. Quart. **4**: 278–292. *2 pl.* Je 1903.
Also as a separate: Contr. Dept. Bot. Columbia Univ. no. 204.

176. Four recently described ferns from Jamaica. Bull. Dep. Agr. Jamaica **1**: 136–138. 1 Jl 1903.

177. Pteridophyta. In: SMALL, JOHN KUNKEL. Flora of the southeastern United States, 1–25. New York, [22 Jl] 1903.

178. Account . . . of explorations in Jamaica. Jour. N. Y. Bot. Garden **4**: 109–119. *pl. 15 + f. 14, 15.* Jl 1903.

179. The early writers on ferns and their collections — I. Linnaeus, 1707–1778. Torreya **3**: 145–150. 30 O 1903.
Also as a separate (in Contr. Dep. Bot. Columbia Univ. no. 214).

180. A new work on ferns. Torreya **3**: 173, 174. 19 N 1903.
A review of Waters' Ferns.

181. A summary of our present knowledge of the ferns of the Philippines. Bull. Torrey Club **30**: 665–684. 5 D 1903.
Also as a separate: Contr. Dep. Bot. Columbia Univ. no. 206.

182. The botanical gardens of Jamaica. [Abstract.] Science **II. 18**: 754, 755. 11 D 1903. — Torreya **3**: 191. 22 D 1903.

1904

183. Report of the Scientific Directors [for 1903]. Bull. N. Y. Bot. Garden **3**: 267, 268. 22 Mr 1904.

184. The early writers on ferns and their collections — II. J. E. Smith, 1759–1828; Swartz, 1760–1818; Willdenow, 1765–1812. Torreya **4**: 49–52. 28 Ap 1904.
Also as a separate (in Contr. Dep. Bot. Columbia Univ. no. 214).

185. *Ceratopteris triangularis* in Alaska. Fern Bull. **12**: 58. "Ap" [My] 1904.

186. *Cyathea* and its allies in Jamaica. [Abstract.] Torreya **4**: 93–95. 8 Je 1904. — Science **II. 20**: 84, 85. 15 Jl 1904.

187. [Review of] The cryptogamic botany of the Harriman Expedition. Science **II. 19**: 917–919. 17 Je 1904.

188. Ferns and fern-allies. Encyclopedia Americana **7**: [308–312]. New York and Chicago. [1904.]

189. The early writers on ferns and their collections — III. W. J. Hooker, 1785–1865. Torreya **4**: 145–150. 29 O 1904.
Also as a separate (in Contr. Dep. Bot. Columbia Univ. no. 214).

1905

190. A glimpse at early botanical literature. Plant World **8**: 25–29. 1905.

191. The early writers on ferns and their collections — IV. Presl, 1794–1852; John Smith, 1798–1888; Fée, 1789-1874; and Moore, 1821–1887. Torreya **5**: 37–41. 22 Mr 1905.
Also as a separate (in Contr. Dep. Bot. Columbia Univ. no. 214).

192. Report of the Scientific Directors [for 1904]. Bull. N. Y. Bot. Garden **4**: 92–94. 8 My 1905.

193. A much-named fern. Torreya **5**: 87–89. 25 My 1905.

194. *Botrychium silaifolium* Presl. Torreya **5**: 106, 107. 24 Je 1905.

195. A summary of Charles Wright's explorations in Cuba. Bull. Torrey Club **32**: 291–300, *map*. 30 Je 1905.
Also as a separate: Contr. Dep. Bot. Columbia Univ. no. 217.

196. The genus *Alcicornium* of Gaudichaud. Bull. Torrey Club **32**: 587–596. 6 D 1905.
Also as a separate: Contr. Dep. Bot. Columbia Univ. no. 221.

1906

197. [Review of] Christensen's Index Filicum. Torreya **5**: 217–219. 10 Ja 1906.

198. The genus *Stenochlaena*. Bull. Torrey Club **33**: 35–50. *f. 1–10*. 8 F 1906.
Also as a separate: Contr. Dep. Bot. Columbia Univ. no. 222.

199. Report of the Scientific Directors [for 1905]. Bull. N. Y. Bot. Garden **5**: 84, 85. 13 F 1906.

200. Six new fern genera in the United States. [Abstract.] Science **II. 23**: 346. 2 Mr 1906. — Torreya **6**: 53. 16 Mr 1906.

201. (With FRANCIS ERNEST LLOYD.) The species of *Lycopodium* of the American tropics. Bull. Torrey Club **33**: 101–124. 14 Mr 1906.
Also as a separate: Contr. Dep. Bot. Columbia Univ. no. 223.

202. Flowerless plants or cryptogams. In: MILLER, WILHELM. A synopsis of the vegetable kingdom, 77–80. In: BAILEY, LIBERTY HYDE, & MILLER, WILHELM. Cyclopedia of American horticulture, ed. 4, vol. **1**. New York, [27 Mr] 1906.

203. American ferns — VI. Species added to the flora of the United States from 1900 to 1905. Bull. Torrey Club **33**: 189–205. 7 Ap 1906.
Also as a separate: Contr. Dep. Bot. Columbia Univ. no. 225.

204. A report on the condition of the tropical laboratory. Jour. N Y. Bot. Garden **7**: 250–255. N 1906.
Reprinted in Bull. Dep. Agr. Jamaica **5**: 93–96. 9 Jl 1907.

205. The number of known ferns. Science **II. 24**: 761–763. 14 D 1906.
Review of Christensen's Index Filicum.

1907

206. American ferns — VII. Bull. Torrey Club **33**: 591–605. *f. 1–16.* 7 F 1907.
A. The American species of *Stenochlaena*, pages 591–603. *f. 1–14.* B. The status of *Poecilopteris crenata* Presl, pages 603–605. *f. 15, 16.*
Also as a separate: Contr. Dep. Bot. Columbia Univ. no. 231.

207. Report of the chairman of the Board of Scientific Directors for 1906. Bull. N. Y. Bot. Garden **5**: 285–289. 7 Mr 1907.

208. Concerning *Woodwardia paradoxa*, a supposedly new fern from British Columbia. Torreya **7**: 73–76. 15 Ap 1907.

209. The progress of our knowledge of the flora of North America. Pop. Sci. Mo. **70**: 497–517. *f. 1–7.* "Je" [My] 1907.
Also as a separate, pages 497–518, two paragraphs being added which were omitted from the original by error.

210. American ferns — VIII. A preliminary review of the North American Gleicheniaceae. Bull. Torrey Club **34**: 243–262. 10 Jl 1907.
Also as a separate: Contr. Dep. Bot. Columbia Univ. no. 234.

211. The names of some of our native ferns. Torreya **7**: 193–198. 18 O 1907.

212. (With WILLIAM RALPH MAXON.) Two new ferns of the genus *Lindsaea*. Smithsonian Misc. Coll. **50**: 335, 336. 28 O 1907.
Also as a separate.

INDEX TO THE PRECEDING BIBLIOGRAPHY

Acarina of North America, 19
Account of explorations in Jamaica, 178
Additions to the flora of Indiana, 60, 87, 114; to the hepatic flora of the Manual region, 55
Adiantum, 141
Alabama: Ferns of, 103; Fungi of, 106, 110
Alcicornium, 196
Alumni record of Syracuse University, 21
America: Arachnology in, 24
American Association: vice-presidential address, 76
American ferns, 119, 122, 155, 165, 168, 203, 206, 210
American Hydnaceae, 107
American species of Marsilea, 22; of Stenochlaena, 206
Arachnology in America, 24
Archegoniates: Classification of, 82
Arthrogastra of North America, 17
Artificial synopses, 4
Aspidieae: American genera of, 155
Aspidium marginale, 2
Asplenium ebenoides, 129

Bailey & Miller: Cyclopedia of horticulture: Ferns, 132, 135, 143, 154, 202
Baker: Handbook of the fern-allies (review), 26
Basidiomycetes, 34, 120

Bibliography of Hepaticae, 66; of Indiana botany, 74; of North American Myriapoda, 68
Biography: Mrs. A. J. Ellis, 128; C. M. Gottsche, 61
Biologist: Report of, 104
Boletaceae of North America, 144
Bollman: Myriapoda, 68
Boreal and sub-boreal hepatic flora, 56
Botanical division of the Indiana Biological Survey: Report of, 74, 87
Botanical gardens of Jamaica, 182
Botanical Society of America: presidential address, 139
Botanists: Notable collection of, 38
Botrychium, 111, 119, 138, 171; silaifolium, 194; ternatum, 108
Bracket fungi, 160
Britton: Manual: Pteridophyta, 149
Britton & Brown: Illustrated flora: Pteridophyta, 95
Buck: Handbook of the medical sciences: Fungi, 159

California: Hepaticae of, 29
Campbell: Mosses and ferns (review), 88; Pilularia globulifera (review), 32; University text-book (review), 161
Cantharellus, 123
Catalogue of North American Hepaticae, 16
Century of illustrative fungi, 34
Cephalozia in North America, 98
Ceratopteris triangularis, 185
Changed conception of species, 148
Check-list of Pteridophyta, 6, 69
Christ: Farnkräuter der Erde (review), 117
Christensen: Index Filicum (review), 197, 205
Classification of the archegoniates, 82
Clover rust, 30
Clute: Our ferns in their haunts (review), 151
Coleosporium Campanulae, 100
Collaborators: Cook, 22, 25, 31, 34, 35, 37, 42, 43, 48, 49, 65, 93, 121; Earle, 90, 96, 99, 110; Howe, 174; Lloyd, 134, 201; Maxon, 162, 212; Osborn, 19
Columbia University Department of Botany and its relation to the New York Botanical Garden, 175
Comparison of the hepatic flora of boreal and sub-boreal regions, 56
Connecting forms among polyporoid fungi, 51
Conservation of energy in mycological clubs, 152
Cook, O. F. (collaborator), 22, 25, 31, 34, 35, 37, 42, 43, 48, 49, 65, 93, 121
Coulter: Botany of western Texas (review), 47; Pteridophyta, 71
Crustacea of North America, 20
Cryptogamic botany of the Harriman Expedition (review), 187
Cryptogams of Indiana, 74
Cuba: Pteridophyta of, 162; Wright's explorations in, 195
Cyathea in Jamaica, 186
Cyclopedia of American horticulture: Ferns, 132, 135, 143, 154, 202

Danaea, 168
Department of Botany and its relation to the New York Botanical Garden, 175
Descriptive catalogue of North American Hepaticae, 16
Diseases: Treatment of, 90
Diseases of the orange, 46
Dissipation of energy in college education, 63
Distribution of Gymnosporangium in the South, 96; of Isoetes, 27; of North American Helvellales, 91; of North American Hepaticae, 44; of North American Marchantiaceae, 80; of tropical ferns in Florida, 59
Dryopteris, 137

Earle, F. S. (collaborator), 90, 96, 99, 110
Early botanical literature, 190
Early writers on ferns, 179, 184, 189, 191
Edible fungi, 77, 101, 159
Ellis, Mrs. A. J., 128
Ellis collection of fungi, 133
Encyclopedia Americana: Ferns, 188
Engler: Syllabus (review), 118
Enumeration of pteridophytes collected in Yukon, 147
Equisetum, 83; variegatum, 12

Evolution of the Hepaticae, 76
Exploration in Cuba by Wright, 195; in Jamaica, 178
Exsiccatae: Century of illustrative fungi, 34; Hepaticae americanae, 25, 31, 35, 37, 42, 48, 49, 65, 93, 121; Indiana flora (fungi), 78

Features of future fern study, 173
Fée, 191
Fern-allies, 26; of the Pacific coast and Mexico, 39
Fern-book offer, 70
Ferns, 140, 169, 176, 193; American, 119, 122, 155, 165, 168, 203, 206, 210; Our native, 5, 11, 28, 67, 92, 136, Southern, 172
Ferns: Genera of, 130
Ferns of Alabama, 103; of Florida, 59; of New York, 7; of the Philippines; 181; of Scolopendrium Lake, 113; of Syracuse, 1; of the United States, 200, 203
Florida: Diseases of the orange in, 46; Tropical ferns in, 59
Flour, 102
Fossombronia, 89
Four new ferns from Jamaica, 176
Fungi: Edible, 77, 101, 159; Illustrative, 34; Poisonous, 159
Fungi: Ellis collection of, 133; Suggestions to collectors of, 110, 112
Fungi of Alabama, 106, 110; of Indiana, 78, 87
Fungous diseases: Treatment of, 90

Genealogy: Pollard, 45; Underwood, 15
Genera of ferns, 130
Generic synopses of the Basidiomycetes and Myxomycetes, 34
Genoa botanical congress, 57, 58, 62, 64
Geological formations crossed by the Syracuse and Chenango Valley Railroad, 3
Giesenhagen: Niphobolus (review), 156
Gleicheniaceae: North American, 210
Glimpse at early botanical literature, 190
Gold and silver ferns, 169
Gottsche, C. M., 61
Gray: Manual: Hepaticae, 36; additions, 55
Gymnogramme, 165
Gymnosporangium in the South, 96

Habitats of the rarer ferns of Alabama, 103
Harriman Expedition: Cryptogamic botany (review), 187
Harshberger: Botanists of Philadelphia (review), 131
Helvellales: North American, 91
Hepatic flora of boreal and sub-boreal regions, 56
Hepaticae, 14, 29, 55, 79; Evolution of, 76; Index of, 66; Notes on, 33, 73, 80, 89
Hepaticae americanae, 25, 31, 35, 37, 42, 48, 49, 65, 93, 121
Hepaticae in Gray's Manual, 36 (additions, 55); in Systematic botany of North America, 79
Hepaticae of Labrador, 53; of North America, 10, 16, 44; of the Pacific coast, 41
Hepaticology: Recent work in, 50
Heterosporous fern-allies of the Pacific coast and Mexico, 39
Historic trees, 167
Hooker, W. J., 189
Howe, M. A. (collaborator), 174
Hydnaceae, American, 107

Illustrative fungi, 34
Index Hepaticarum, 66
Index to the species of Botrychium, 171
Indiana: Cryptogams of, 74, 87, 114; Flora of, 60, 78, 87; Fungi of, 78; Pear disease in, 84; Pteridophyta of, 75
Indiana State Biological Survey: Report of botanical division, 74, 87
International catalogue of scientific literature, 126, 170
International congress at Genoa, 57, 58, 62, 64
Isoetes, 27

Jamaica: Botanical gardens of, 182; Botrychium from, 138; Cyathea in, 186; Explorations in, 178; Ferns from, 176

Kew: Royal Botanic Gardens at, 124

Labrador: Hepaticae of, 53
Lastraea, 137
Lejeunea, 40
Lindsaea, 212
Linnaeus, 179
List of Acarina of North America, 19; of Alabama fungi, 110; of Arthrogastra of North America, 17; of cryptogams of Indiana, 74; of ferns of Syracuse, 1; of fresh-water Crustacea of North America, 20; of Hepaticae of North America, 16; of mosses collected in the Yakima region, 43; of Pacific coast Hepaticae, 41; of Pteridophyta collected in the Yukon, 147
Litchfield County, Connecticut: Pteridophyta of, 13
Literature: Early botanical, 190
Literature of mycophagy, 142
Lloyd, F. E. (collaborator), 134, 201
Lycopodium: North American species of, 134; Tropical American species of, 201
Lycopodium tristachyum, 146

Marchantiaceae, North American, 80
Marsilea, North American species of, 22
Maxon, W. R. (collaborator), 162, 212
Mexico: Heterosporous fern-allies of, 39
Minor inaccuracies, 158
Moore, 191
Mosses of the Yakima region, 43
Moulds, mildews, and mushrooms, 127
Mycological clubs, 152
Mycology in the southern states, 94
Mycophagy and its literature, 142
Myriapoda: North American, 18, 68
Myxomycetes, 34

Names of our ferns, 145, 211
New Adiantum from New Mexico, 141
New Botrychium from Jamaica, 138
New Cantharellus from Maine, 123
New Lejeunea, 40
New Selaginella from Mexico, 72
New York: Ferns of, 7
New York Botanical Garden: Relation to the Department of Botany of Columbia University, 175; Report of the Scientific Directors, 157, 173, 183, 192, 199, 207; Report on the tropical laboratory, 204
Nomenclature, 52, 57
North America: Acarina of, 19; Arthrogastra of, 17; Boletaceae of, 144; Cephalozia in, 98; Fresh-water Crustacea of, 20; Gleicheniaceae of, 210; Helvellales of, 91; Hepaticae of, 10, 16, 33, 44 73, 80, 89; Lycopodium in, 134; Marchantiaceae of, 80; Myriapoda of, 18, 68; Pteridophyta of, 6, 69; Selaginellae of, 153
Notable collection of botanists, 38
Notes on Cuban Pteridophyta, 162; on Hepaticae, 33, 73, 80, 89; on the heterosporous fern-allies of the Pacific coast and Mexico, 39; on Hydnaceae, 107; on Marsilea, 22; on Peridermium, 99; on southern ferns, 172; on Trillium, 97

Onoclea, 9
Orange: Diseases of, 46
Osborn, H. (collaborator), 19
Our genera of Aspidieae, 155
Our native ferns, 5, 11, 28, 67, 92, 136
Our present knowledge of the distribution of pteridophytes in Indiana, 75

Pacific coast: Heterosporous fern-allies of, 39; Hepaticae of, 41
Parasitic fungi of Indiana, 78, 87
Parsons: How to know the ferns (review), 125
Pear disease, 84
Peridermium, 99
Phanerophlebia, 122
Philippines: Ferns of the, 181
Plant record, 8
Poecilopteris crenata, 206
Poisonous fungi, 159
Pollard, J., 45
Polypodium vulgare, 54
Polyporoid fungi: Connecting forms of, 51
Polyporus lucidus, 85
Porto Rico: Report on a trip to, 150
Preliminary comparison of the hepatic flora of boreal and sub-boreal regions, 56
Preliminary list of Acarina of North America, 19; of Alabama fungi, 110;

of Arthrogastra of North America, 17; of Pacific coast Hepaticae, 41
Preliminary review of North American Gleicheniaceae, 210
Presl, 191
Progress of Arachnology in America, 24; of our knowledge of the flora of North America, 209
Proposed new Systematic botany of North America, 86
Pteridophyta: Check-list of, 6, 69
Pteridophyta in Bailey & Miller's Cyclopedia of horticulture, 132, 135, 143, 154, 202; in Britton's Manual, 149; in Britton & Brown's Illustrated flora, 95; in Coulter's Botany of western Texas, 71; in Encyclopedia Americana, 188; in Small's Flora, 177
Pteridophyta of Cuba, 162; of Indiana, 75; of Litchfield County, 13; of Yukon, 147
Putnam County, Indiana: Additions to flora of, 60

Question in terminology, 166

Rarer ferns of Alabama, 103
Recent work in systematic hepaticology, 50
Relations of the red cedar to our orchards, 81
Report of the Biologist, 104; of the botanical division of the Indiana Biological Survey, 74, 87; of the Scientific Directors, 157, 173, 183, 192, 199, 207; on the condition of the tropical laboratory, 204; on a trip to Porto Rico, 150
Review of the genera of ferns, 130; of the North American Gleicheniaceae, 210; of the North American species of Lycopodium, 134
Reviews: Baker, Handbook of fern-allies, 26; Campbell, Mosses and ferns, 88; Campbell, Pilularia globulifera, 32; Campbell, University text-book, 161; Christ, Farnkräuter der Erde, 117; Christensen, Index Filicum, 197, 205; Clute, Our ferns in their haunts, 151; Coulter, Botany of western Texas, 47; Cryptogamic botany of the Harriman Expedition, 187; Engler, Syllabus, 118; Giesenhagen, Niphobolus, 156; Harshberger, Botanists of Philadelphia, 131; International catalogue, 170; Parsons, How to know the ferns, 125; Setchell, Laboratory practice, 109; Waters, Ferns, 180
Riccia, 73, 79
Riella, 174
Royal Botanic Gardens at Kew, 124
Rust of clover, 30

Schweinitz and American Hepaticae, 14
Scientific Directors: Report of, 157, 173, 183, 192, 199, 207
Scolopendridae of the United States, 23
Scolopendrium Lake: Ferns of, 113
Selaginella, 72, 164; rupestris, 115
Selaginellae of North America, 153
Setchell: Laboratory practice (review), 109
Silver ferns, 169
Six new fern genera in the United States, 200
Small: Flora: Pteridophyta, 177
Smith, J., 191; J. E., 184
Some features of future fern study, 163
Some historic trees, 167
Some new fungi, 106
Some points in the nomenclature-priority question, 52
Some undescribed Hepaticae from California, 29
Southern ferns, 172
Southern states: Gymnosporangium in the, 96; Mycology in the, 94
Species of Botrychium, 111
Stenochlaena: American species of, 206; Old-world species of, 198
Study of botany in high schools, 116
Suggestions for the study of Boletaceae, 144
Suggestions to collectors of fungi, 110, 112
Summary of our knowledge of the ferns of the Philippines, 181; of Charles Wright's explorations in Cuba, 195
Swartz, 184
Synopses, 4; of the Basidiomycetes and Myxomycetes, 34

Syracuse: Ferns of, 1
Syracuse and Chenango Valley Railroad, 3
Syracuse University: Alumni record of, 21
System of ferns proposed in Die natürlichen Pflanzenfamilien, 140
Systematic botany of North America, 86; Hepaticae, 79
Systematic plant record, 8

Terminology, 105, 166
Ternate species of Botrychium, 119
Thallophytes: Terminology of, 105
Treatment of fungous diseases, 90
Trees, Historic, 167
Trichomanes Petersii, 103
Trillium, 97
Tropical ferns in Florida, 59
Tropical laboratory, 204

Underwood families of Massachusetts, 15
United States: Ferns added to the flora of, 203; Scolopendridae of, 23

Variations of Polyporus lucidus, 85
Varieties of Botrychium ternatum, 108

Waters: Ferns (review), 180
Why Dryopteris and not Lastraea? 137
Willdenow, 184
Woodwardia paradoxa, 208
Wright's explorations in Cuba, 195
Writers on ferns and their collections, 179, 184, 189, 191

Yakima region: Mosses collected in the, 43
Yukon: Pteridophyta collected in, 147

Professor Underwood's relation to the work of the New York Botanical Garden*

NATHANIEL LORD BRITTON

Through his appointment as professor of botany in Columbia University, Professor Underwood became by virtue of this office a member of the Board of Scientific Directors of the New York Botanical Garden in 1896. He has thus been a member of the Board of Managers of the Garden throughout its entire period of development. He has been fertile in advice and suggestion concerning all the educational and research work of the institution, and has been indefatigable in the building up of its collections, especially the museum and herbarium series of cryptogamic plants. The voluntary curatorial work on the collections of ferns and fungi accomplished by him has been of unusual value owing to his intimate knowlege of these groups, and students under his direction have greatly increased the value of the cryptogamic collections, both by the addition of specimens and by the critical determination of collections already secured. He kept the Garden in touch with students of ferns all over the world, and it will be long before the institution has the advantage of the presence of an authority such as Professor Underwood on ferns and fern allies, his chosen field.

The herbarium collections accumulated by Professor Underwood during his busy life are already in part the property of the Garden, he having presented all his flowering plants, and his pteridophytes and Hepaticae having been purchased, the latter being bought in 1907. His collections of fungi and of mosses are at Columbia University.

In recognition of Professor Underwood's services to the Garden and of his contributions to botanical science, the Board of Managers have resolved to designate the entire fern herbarium of the Garden "The Underwood Fern Herbarium," and to place a suitable tablet on one of the cases containing these collections.

* Read at a memorial meeting of the Torrey Botanical Club, January 29, 1908.

The Scientific Directors of the Garden have adopted the following preamble and resolution:

WHEREAS, Death has removed from this Board Professor Lucien Marcus Underwood, our associate from the commencement of our organization, and our chairman since the year 1901,

We therefore desire to record an expression of our profound sorrow at the severance of such happy personal relations as have always existed between the deceased and the members of this Board, and at the untimely ending of a career of such present value and of such great promise.

We desire also to place upon record our appreciation of the great value to the New York Botanical Garden of the services rendered by Professor Underwood, both in his official capacity, and by virtue of his high and broad scholarship.

As our chairman, Professor Underwood has always performed his duties in a prompt, studious, and efficient manner, and has shown rare wisdom in conserving the higher interests of the institution and of those served by it.

As an original investigator in those lines of research which it is the object of the Garden to promote, Professor Underwood has displayed untiring energy, combined with independence and originality, and his work has been fruitful in many important contributions to science.

As an advisor and guide in the investigations of others, here and elsewhere, Professor Underwood has exerted a wide influence, and has displayed unselfish devotion and a generous regard for the interests of those so engaged.

The cheerfulness and general good-fellowship of Professor Underwood in his personal relations with us, and with the members of the Garden staff, has been such as to combine the most pleasant recollections with the most sorrowful regret that we are to enjoy him no more.

Resolved, That a copy of this memorial be transmitted to the family of Professor Underwood, and that the same be entered upon our minutes and published in the Garden *Journal*.

Resolutions adopted by the Torrey Botanical Club and other scientific organizations in relation to the death of Lucien Marcus Underwood

The Torrey Botanical Club

At a memorial meeting of the Torrey Botanical Club, held at the museum of the New York Botanical Garden, January 29, 1908, the following minute was adopted:

In the death of Lucien Marcus Underwood American botany has lost one of its foremost representatives; one who was exceptionally free from prejudice and selfishness and who abhorred all superficiality and obsequiousness. The Torrey Botanical Club has lost a faithful officer and a zealous and enthusiastic supporter of all its activities and interests.

We desire to pay tribute to his superior qualifications and attainments as a man of science, and to express our profound sorrow as we attempt to realize that we shall no more feel the warm clasp of his hand, meet the glance of his sympathetic eye, or hear his cheering words of counsel and encouragement.

The Torrey Botanical Club hereby directs that this minute be entered in its proceedings and duly published with them.

The American Association for the Advancement of Science

At the fifty-eighth meeting of the American Association for the Advancement of Science, held at the University of Chicago, December 30, 1907, to January 4, 1908, the following resolutions were adopted by Section G (botany):

Whereas: By the lamented death of Dr. Lucien Marcus Underwood, late professor of botany in Columbia University, science has suffered a severe loss and the American Association for the Advancement of Science, particularly the Botanical Section, has been deprived of an active and esteemed member, be it

Resolved, That this society place on record its recognition of his fruitful labor along his chosen lines in the field of scientific research and instruction, and its keen appreciation of the stimulating influence of his personal character and scholarly attainments.

THE PHILADELPHIA BOTANICAL CLUB

At a meeting of the Philadelphia Botanical Club, held on the evening of November 21, 1907, the following resolutions were adopted:

WHEREAS: The Philadelphia Botanical Club has learned of the sad death of the distinguished botanist, Lucien M. Underwood, professor of botany in Columbia University, be it

Resolved, That by his death botanical science has suffered an irreparable loss, his personal character, his professional standing, and his scientific attainments, particularly in his special line of work on the ferns and allied plants, having won for him the sincere admiration and regard not only of his associates, but of his fellow workers in the field of science.

Resolved, That the Philadelphia Botanical Club records its appreciation of his labors and its deep sense of the loss which American botanical science has sustained.

THE FERN CLASS OF THE BOTANICAL SOCIETY OF PENNSYLVANIA

The Fern Class of the Botanical Society of Pennsylvania, now assembled, having learned of the death of the well-known botanist, Lucien M. Underwood, professor of botany in Columbia University, desires to place on the record of its minutes the following appreciation of his earnest and fruitful labors, and its deep sense of the loss which botanical science has sustained.

By the death of Dr. Underwood botanical science has suffered an irreparable loss. His personal character, his professional qualifications, and his scientific attainments, particularly in his special field of work on the ferns and other lower orders of plants had won for him the loving regard of his associates and the sincere admiration of his fellow workers in the field of science.

PHILADELPHIA, November 23, 1907.

[*Signed*]

Adolph W. Miller, Pres.
John M. Macfarlane, Sec'y.
Henry Kraemer
Marion Mackenzie
S. L. Schumo
L. D. Woodbridge
Sam'l P. Seese, M.D.
Mary G. Spencer
Caroline A. Burgin
Thos. Spencer
Emma T. Fell
Mrs. W. Findlay
Wm. Findlay
George T. Hastings

E. B. Ulrich
E. Newton Harvey
Lucy C. Gendell
Chas. S. Williamson
Katharine S. Nicholson
Martha H. Hollinshead
Florence Yaple
Carlotta H. Browne
Mrs. Geo. T. Hastings
Mary L. Yarnall
Edith H. Abbott
Lydia R. Linvill
Edith M. Farr
Ernest K. Thomas
Lydia Prichett Borden
Herbert Greensmith
Henry C. Savage.

INDEX TO AMERICAN BOTANICAL LITERATURE
(1907)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions their kindness will be appreciated.

This Index is reprinted monthly on cards, and furnished in this form to subscribers, at the rate of one cent for each card. Selections of cards are not permitted; each subscriber must take all cards published during the term of his subscription. Correspondence relating to the card-issue should be addressed to the Treasurer of the Torrey Botanical Club

Andrews, E. A. Earthworms as planters of trees. Am. Nat. **41**: 711–714. 9 D 1907.

Ascuith, C. H. Collection of Alaskan plants. Plant World **10**: 282–285. D 1907.

Bailey, W. W. Chicory. Am. Bot. **13**: 54–56. D 1907.

Beissner, L. Mitteilungen iiber Coniferen. Mitteil. Deuts. Dendr. Gesells. **16**: 101–117. 1907. [Illust.]

Berry, E. W. Pleistocene plants from Alabama. Am. Nat. **41**: 689–700. *pl. 1, 2.* D 1907.

Bradshaw, M. F. Overcoming difficulties. Am. Bot. **13**: 52, 53. D 1907.

Note on *Ipomoea hederacea.*

Britton, N. L. & Rose, J. N. *Pereskiopsis,* a new genus of *Cactaceae.* Smithson. Misc. Coll. **50**: 331–334. *pl. 43, 44.* 28 O 1907.

Includes ten species; two new, *P. Kellermanii* Rose and *P. velutina* Rose.

Campbell, D. H. On the distribution of the Hepaticae and its significance. New Phytol. **6**: 203–212. 31 O 1907.

Chodat, R. Étude critique des genres *Scoparia* L. et *Hasslerella* Chod. Bull. Herb. Boiss. II. **8**: 1–16. 28 D 1907.

Includes *S. Aemilii* Chod. sp. nov.

Cogniaux, A. Notes sur les orchides du Brésil et des régions voisines. Bull. Soc. Roy. Bot. Belg. **43**: 266–356. 30 Ap 1907.

Drabble, E. & Nierenstein, M. Bastard logwood from Jamaica. Bull. Dept. Agr. Jamaica **5**: 185–187. 16 O 1907.
Reprinted from Quar. Jour. Inst. Com. Research, Liverpool.

Eastwood, A. Notes on California plants. Muhlenbergia **3**: 133, 134. 7 D 1907.

Finet, M. A. Orchidées nouvelles ou peu connues. Bull. Soc. Bot. France IV. **7**: 531–537. 1 D 1907.
Includes three new American species in *Microstylis* and in *Pseudoliparis* gen. nov.

Gager, C. S. The evaporating power of the air at the New York Botanical Garden. Jour. N. Y. Bot. Gard. **8**: 269–274. *f. 37.* D 1907.

Greenman, J. M. New or noteworthy spermatophytes from Mexico, Central America, and the West Indies. Field Columb. Mus. Publ. Bot. **2**: 247–287. 31 D 1907.
Includes *Goldmania*, a new genus of the Compositae, and 35 new species in Compositae and other families.

Heller, A. A. A new name. Muhlenbergia **3**: 134. 7 D 1907.
Carduus longissimus Heller.

Heller, A. A. The genus *Chloropyron*. Muhlenbergia **3**: 133, 134. 7 D 1907.
Includes four new combinations.

Hermer, J. Fruchtende *Umbellularia californica* Nutt. Mitteil. Deuts. Dendr. Gesells. **16**: 259. 1907.

Herms, W. B. Contribution to the life history of *Asimina triloba*. Ohio Nat. **8**: 211–217. *pl. 15, 16.* 28 D 1907.

Holdt, F. von. Bemerkungen über wertwolle amerikanische Gehölze. Mitteil. Deuts. Dendr. Gesells. **16**: 273, 274. 1907.

Jepson, W. L. The deer oak. Muhlenbergia **3**: 130, 131. D 1907.

Koch, F. J. Wild flowers of the "Tip-top" bottom. Plant World **10**: 276–278. D 1907.

Léveillé, H. Monographie synthétique et inconographique du genre *Epilobium*. Bull. Acad. Internat. Géogr. Bot. **16**: 241–305. 25 N 1907. [Illust.]

Lewis, F. T. A further study of leaf development. Am. Nat. **41**: 701–709. *f. 1a–15c.* 9 D 1907.

Livingston, B. E. Evaporation and plant development. Plant World **10**: 268–276. D 1907.

MacDougal, D. T. The pedregal. Plant World **10**: 285–287. *f. 56, 57.* D 1907.

Niles, G. G. Ghost plants. Am. Bot. **13**: 49–52. D 1907. [Illust.]

Parish, S. B. Notes on the flora of Palm Springs. Muhlenbergia **3**: 121–128. D 1907.

Rebman, —. *Juglans regia* und *Juglans nigra*. Mitteil. Deuts. Dendr. Gesells. **16**: 187–209. 1907.

Reed, H. S. The malignant effect of certain trees upon the surrounding plants. Plant World **10**: 279–282. *f. 55*. D 1907.

Rehder, A. Einige neuere oder seltenere Gehölze. Mitteil. Deuts. Dendr. Gesells. **16**: 69–76. 1907.

Includes *Juniperus communis Jackii* var. nov., and eight formae novae in other genera.

Ritzerow, H. Über Bau und Befruchtung kleistogamer Blüten. Flora 98: 163–212. *f. 1–36*. 15 N 1907.

Robertson, A. The *Taxoideae*. New Phytol. **6**: 92–102. *pl. 1*. Ap 1907.

Rose, J. N. *Nopalea guatemalensis*, a new cactus from Guatemala. Smithson. Misc. Coll. **50**: 330. *pl. 41, 42*. 28 O 1907.

Rusby, H. H. The work of Professor Lucien Marcus Underwood. Jour. N. Y. Bot. Gard. **8**: 263–269. *pl. 42*. D 1907.

Schwappach, —. Über den Wert der verschiedenen Formen der Douglas-fichte. Mitteil. Deuts. Dendr. Gesells. **16**: 123–125. 1907.

Schwappach, —. Über die wichtigsten ausländischen, für deutsche Forsten geeigneten Laubholzarten. Mitteil. Deuts. Dendr. Gesells. **16**: 126–135. 1907.

Souèges, R. Développement et structure du tégument séminal chez les Solanacées. Ann. Sci. Nat. Bot. IX. **6**: 1–124. *f. 1–206*. N 1907.

Stephani, F. Species *Hepaticarum*. Bull. Herb. Boiss. II. **8**: 49–64. 28 D 1907.

Includes seven new species (one American), and four new names (two American), in *Chiloscyphus*.

Thompson, H. S. Note sur les *Juncus bicephalus* Viviani et *J. bufonius* v. *fasciculatus* Koch. Bull. Herb. Boiss. II. **8**: 75, 76. 28 D 1907.

Notes the occurrence of the second in America.

Underwood, L. M. & Maxon, W. R. Two new ferns of the genus *Lindsaea*. Smithson. Misc. Coll. **50**: 335, 336. 28 O 1907.

Van Tieghem, P. Structure du pistil et du fruit des Labiées, des Borragacées, et des familles voisines. Ann. Sci. Nat. Bot. IX. **5**: 321–350. N 1907.

Van Tieghem, P. Sur les Inovulées. Ann. Sci. Nat. Bot. IX. **6**: 125–258. D 1907.

Voos, A. Coniferen-Nomenklatur-Tabelle. Mitteil. Deuts. Dendr. Gesells. **16**: 88–95. 1907.

Woronin, H. Apogamie und Aposporie bei einigen Farnen. Flora **98**: 101–162. *f. 1–72.* 15 N 1907.

Zabel, H. Über die notwendig gewordene Ablehnung der neueren Pflanzenbenennungen einiger nordamerikanischer Botaniker. Mitteil. Deuts. Dendr. Gesells. **16**: 86, 87. 1907.

THE BRYOLOGIST

WITH THE JANUARY, 1908, NUMBER BEGINS ITS

ELEVENTH YEAR AND VOLUME

It is a 16–20 page bi-monthly devoted to the study of the Mosses, Hepatics, and Lichens. It is fully illustrated with new, original, and artistic drawings and half-tones. It is indispensable to the working bryologist, professional as well as amateur. Send for sample copy. Subscription price $1.00 a year.

Address, MRS. ANNIE MORRILL SMITH, 78 Orange Street, Brooklyn, N. Y.

INDEX TO AMERICAN BOTANICAL LITERATURE

This Index, printed each month in the BULLETIN, is reissued on library catalogue cards; these are furnished to subscribers at the rate of one cent for each card.

Subscriptions to the card-issue may be addressed to the Treasurer of the Torrey Botanical Club,

WILLIAM MANSFIELD, COLLEGE OF PHARMACY, 115 W. 68th St., N. Y. City.

Beginning with January, 1903, the Index has also been reprinted on paper, on one side only, and can be furnished in that form at the rate of $3.00 a year.

North American Flora

THIS work is designed to present descriptions of all plants growing independent of cultivation, in North America, here taken to include Greenland, Central America, the Republic of Panama, and the West Indies, except Trinidad, Tobago, and Curaçao and other islands off the north coast of Venezuela, whose flora is essentially South American.

It will be published in parts at irregular intervals by the New York Botanical Garden through the aid of the income of the David Lydig Fund bequeathed by Charles P. Daly.

It is planned to issue parts as rapidly as they can be prepared, the extent of the work making it possible to commence publication at any number of points. The completed work will form a series of volumes with the following sequence:

Volume 1. Mycetozoa, Schizophyta, Diatomaceae.
Volumes 2 to 10. Fungi.
Volumes 11 to 13. Algae.
Volumes 14 and 15. Bryophyta.
Volume 16. Pteridophyta and Gymnospermae.
Volumes 17 to 19. Monocotyledones.
Volumes 20 to 30. Dicotyledones.

The preparation of the work has been referred by the Scientific Directors of the Garden to a committee consisting of Professors L. M. Underwood and N. L. Britton.

Professor George F. Atkinson of Cornell University, Professors Charles R. Barnes and John M. Coulter of the University of Chicago, Mr. Frederick V. Coville of the United States Department of Agriculture, Professor Edward L. Greene of the United States National Museum, Professor Byron D. Halsted of Rutgers College and Professor William Trelease of the Missouri Botanical Garden have consented to act as an advisory committee.

The subscription price is fixed at $1.50 for each part; it is expected that four or five parts will be required for each volume. A limited number of separate parts will be sold at $2.00 each. Address,

THE NEW YORK BOTANICAL GARDEN

BRONX PARK, NEW YORK CITY

Vol. 7, Part 1, Ustilaginales, including Ustilaginaceae and Tilletiaceae, by G. P. Clinton, was issued Oct. 4, 1906. Vol. 7, Part 2, Coleosporiaceae, Uredinaceae and Aecidiaceae (pars), of the Uredinales, by J. C. Arthur was issued March 6, 1907. Vol. 22, Part 1, including Podostemonaceae by George V. Nash, Crassulaceae by N. L. Britton and J. N. Rose, and Penthoraceae and Parnassiaceae by P. A. Rydberg, was issued May 22, 1905. Vol. 22, Part 2, including Saxifragaceae and Hydrangeaceae by J. K. Small and P. A. Rydberg, Cunoniaceae, Iteaceae, and Hamamelidaceae by N. L. Britton, Pterostemonaceae by J. K. Small, Altingiaceae by Percy Wilson and Phyllonomaceae by H. H. Rusby, was issued Dec. 18, 1905. Vol. 25, Part 1, including Geraniaceae, by L. T. Hanks and J. K. Small, Oxalidaceae and Linaceae by J. K. Small, and Erythroxylaceae by N. L. Britton, was issued Aug. 24, 1907. Vol. 9, Part 1, Polyporaceae (pars), by W. A. Murrill, was issued Dec. 19, 1907.

PUBLICATIONS BY OFFICERS AND STUDENTS OF THE DEPARTMENT OF BOTANY, COLUMBIA UNIVERSITY

1. MEMOIRS OF THE DEPARTMENT:

Vol. 1. A Monograph of the North American Species of the Genus *Polygonum* (1895). By John Kunkel Small, Fellow in Botany, 1893–1895; Curator of the Herbarium, 1895–1898.

Quarto, 178 pages, 84 plates. Price $6.00.

Vol. 2. A Monograph of the North American Potentilleae (1898). By Per Axel Rydberg, Fellow in Botany, 1896–7.

Quarto, 224 pages, 112 plates. Price $6.00.

2. CONTRIBUTIONS FROM THE DEPARTMENT:

Vol. 1. Nos. 1–25. 1886–1892. Price $5.00.
Vol. 2. Nos. 26–50. 1892–1894. Price $5.00.
Vol. 3. Nos. 51–75. 1894–1895. Price $5.00.
Vol. 4. Nos. 76–100. 1895–1896. Price $5.00.
Vol. 5. Nos. 101–125. 1896–1897. Price $5.00.
Vol. 6. Nos. 126–150. 1897–1898. Price $5.00.
Vol. 7. Nos. 151–175. 1898–1901. Price $5.00.
Vol. 8. Nos. 176–200. 1901–1902. Price $5.00.
Vol. 9. Nos. 201–. 1903–(current).

List of separate numbers available on application.

3. A Text-book of General Lichenology (1896). By Albert Schneider, Fellow in Botany, 1895–1896.

Octavo, 230 pages, 76 plates. Price $4.25 (cloth); $3.80 (paper). Published by Willard N. Clute & Co. Binghamton, N. Y.

The Department invites propositions relative to exchanges of herbarium material for any of the above named publications. Address Dr. Carlton C. Curtis, Columbia University, N. Y. City.

4. An Illustrated Flora of the Northern United States, Canada, and the British Possessions from Newfoundland to the Parallel of the Southern Boundary of Virginia, and from the Atlantic Ocean westward to the 102d Meridian (1896–1898). By Nathaniel Lord Britton, Professor of Botany, 1891–1896; Emeritus Professor 1896–, and Hon. Addison Brown.

Three volumes, royal octavo. Vol. 1, 612 pages; Vol. 2, 642 pages; Vol. 3, 588 pages; 4162 figures in the text, illustrating every species described.

Published by Charles Scribner's Sons, New York. Price, in cloth, $9.00 for the three volumes; with the indexes and keys bound separately, $10.00.

5. Our Native Ferns and their Allies. (Sixth Edition) 1900. By Lucien Marcus Underwood, Professor of Botany, 1896–1907.

Duodecimo, 158 pages, 35 figures. Published by Henry Holt & Co., New York. Price, $1.00.

6. Moulds, Mildews, and Mushrooms. By Lucien Marcus Underwood, Professor of Botany, 1896–1907.

Duodecimo, 236 pages, 10 plates. Published by Henry Holt & Co. Price $1.50.

7. Nature and Development of Plants (1907). By Carlton Clarence Curtis, Assistant in Botany, 1892–1895; Tutor in Botany, 1895–1906; Instructor in Botany, 1906–.

Octavo, 471 pages; 342 illustrations. Published by Henry Holt & Co., New York. Price $2.50.

ESTABLISHED 1851

EIMER & AMEND

205–211 Third Ave.,
Corner 18th Street

NEW YORK

MANUFACTURERS AND IMPORTERS OF

Chemicals and Chemical Apparatus

Our Specialties

MICROSCOPES
and
ACCESSORIES

MICROTOMES

BALANCES
and
WEIGHTS

Sole Agents for

C. A. F.
KAHLBAUM'S
C. P. Chemicals
and Reagents

CARL
SCHLEICHER
& SCHÜLL'S
C. P. Filters

SCHOTT &
GENOSSEN'S
Famous Laboratory Glassware

And for many other renowned European houses in our line.

COMPLETE LINE OF

Bacteriological Apparatus

WE HANDLE

EVERYTHING NEEDED FOR A LABORATORY

Inspection of premises cordially invited.

MEMOIRS OF THE TORREY BOTANICAL CLUB

A series of technical papers on botanical subjects, published at irregular intervals. Price $3.00 a volume. Not offered in exchange.

Vol. 1, No. 1; not furnished separately:

Bailey, Liberty Hyde. Studies of the types of various species of the genus *Carex*. Pages 1–85. 25 My 1889.

Vol. 1, No. 2; not furnished separately:

Martindale, Isaac Comly. Marine algae of the New Jersey coast and adjacen waters of Staten Island. Pages 87–111. 24 Au 1889.

Vol. 1, No. 3; price, 75 cents:

Spruce, Richard. *Hepaticae* Bolivianae, in Andibus Boliviae orientalis, annis 1885–6, a cl. H. H. Rusby lectae. Pages 113–140. 20 Ja 1890.

Vol. 1, No. 4; price, 75 cents:

Sturtevant, Edward Lewis. On seedless fruits. Pages 141–187. 30 My 1890.

Vol. 2, No. 1; not furnished separately:

Halsted, Byron David. Reserve food-materials in buds and surrounding parts. Pages 1–26, *plates 1, 2*. 10 S 1890.

Vol. 2, No. 2; price, 75 cents:

Vail, Anna Murray & Hollick, Charles Arthur. Contributions to the botany of Virginia. Pages 27–56, *plates 3, 4*. 23 D 1890.

Vol. 2, No. 3; not furnished separately:

Holm, Herman Theodor. Contributions to the knowledge of the germination of some North American plants. Pages 57–108, *plates 5–19*. 15 Ap 1891.

Vol. 2, No. 4; price, 75 cents:

Wheelock, William Efner. The genus *Polygala* in North America. Pages 109–152. 30 D 1891.

Vol. 3, No 1; not furnished separately:

Small, John Kunkel & Heller, Amos Arthur. Flora of western North Carolina and contiguous territory. Pages 1–39. 20 F 1892.

Vol 3, No. 2; price, $2.00:

Morong, Thomas. The *Naiadaceae* of North America [with illustrations of all the species]. Pages 1–65, *plates 20–74*. 15 Mr 1893.

Vol. 3, No. 3; not furnished separately:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. [Part 1.] Pages 1–67. 28 Ap 1893.

Vol. 4, No. 1; not furnished separately:

Underwood, Lucien Marcus. Index *Hepaticarum*. Part I, Bibliography. Pages 1–91. 10 Je 1893.

Vol. 4, No. 2; not furnished separately:

Small, John Kunkel & Vail, Anna Murray. Report on the botanical exploration of southwestern Virginia during the season of 1892. Pages 93–201, *plates 75–82*. 18 N 1893–17 Ap 1894.

Vol. 4, No. 3; price, 50 cents:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 2. Pages 203–274. 10 Mr–17 Ap 1895.

Vol. 4, No. 4; price, 50 cents:

Pettit, Anna Stockton. *Arachis hypogaea* L. Pages 275–296, *plates 83–85* 5 Je 1895.

Vol. 4, No. 5; price, 75 cents:

Rydberg, Per Axel. The North American species of *Physalis* and related genera. Pages 297–374. 15 S 1896.

Vol. 5; price, $3.00:

List of *Pteridophyta* and *Spermatophyta* growing without cultivation in northeastern North America. Pages 1–377. 4 D 1893–31 D 1894.

Vol. 6, No. 1; price, $1.25:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 3. Pages 1–130. 17 N 1896.

Vol. 6, No. 2; not furnished separately:

Grout, Abel Joel. A revision of the North American *Isotheciaceae* and *Brachythecia*. Pages 131–210. 30 Jl 1897.

Vol. 6, No. 3; price, 50 cents:

Hazen, Tracy Elliot. The life history of *Sphaerella lacustris* (*Haematococcus pluvialis*). Pages 211–246, *plates 86, 87* (*colored*). 8 Je 1899.

Vol. 6, No. 4; price, 50 cents:

Underwood, Lucien Marcus. A review of the genera of ferns proposed prior to 1832. Pages 247–283. 1 D 1899.

Vol. 6, No. 5; price, 25 cents:

Fink, Bruce. Notes on lichen distribution in the upper Mississippi Valley. Pages 285–307. 1 D 1899.

Vol. 7; price, $3.00:

Howe, Marshall Avery. The *Hepaticae* and *Anthocerotes* of California. Pages 1–208, *plates 88–122*. 5 Au 1899.

Vol. 8, No. 1; not furnished separately:

Lloyd, Francis Ernest. The comparative embryology of the *Rubiaceae*. Part I. Pages 1–26, *plates 1–4*. 26 Au 1899. Part II. Pages 27–112, *plates 5–15*. 15 F 1902.

Vol. 8, No. 2; price, $1.00:

Evans, Alexander William. The *Lejeuneae* of the United States and Canada. Pages 113–183, *plates 16–22*. 15 F 1902.

Vol. 8, No. 3; price, 75 cents:

Britton, Elizabeth Gertrude & Taylor, Alexandrina. The life history of *Vittaria lineata*. Pages 185–211, *plates 23–31*. 30 Au 1902.

Vol. 9; price, $3.00:

Salmon, Ernest Stanley. A monograph of the *Erysiphaceae*. Pages 1–292, *plates 1–9*. 4 O 1900.

Vol. 10; price, $3.00:

Burgess, Edward Sandford. History of Pre-Clusian botany in its relation to *Aster*. Pages i–xii, 1–447. 22 N 1902.

Vol. 11, No. 1; price, $1.75:

Griffiths, David. The North American *Sordariaceae*. Pages 1–134, *plates 1–19*. 30 My 1901.

Vol. 11, No. 2; price, $1.75:

Hazen, Tracy Elliot. The *Ulothricaceae* and *Chaetophoraceae* of the United States. Pages 135–250, *plates 20–42*. 20 O 1902.

Vol. 12, No. 1; price, $1.50:

Northrop, Alice Rich. Flora of New Providence and Andros (Bahama Islands). Pages 1–98, *plates 1–19 + map*. 10 D 1902.

Vol. 12, No. 2; price, $1.00:

Banker, Howard James. A contribution to a revision of the North American *Hydnaceae*. Pages 99–194. 13 Je 1906.

Vol. 12, No. 3; price, 75 cents:

Kupfer, Elsie. Studies in Plant Regeneration. Pages 195–241. 10 Je 1907.

Vol. 13; price, $3.00:

Burgess, Edward Sandford. Species and variations of Biotian Asters, with discussion of variability in *Aster*. Pages i–xv, 1–419, *plates 1–13*. 15 Mr 1906.

Address: **TORREY BOTANICAL CLUB,**
Columbia University, New York City.

VOL. 35 FEBRUARY, 1908 NO. 2

BULLETIN

OF THE

TORREY BOTANICAL CLUB

Editor

MARSHALL AVERY HOWE

Associate Editors

JOHN HENDLEY BARNHART
JEAN BROADHURST
PHILIP DOWELL
ALEXANDER WILLIAM EVANS
TRACY ELLIOT HAZEN
WILLIAM ALPHONSO MURRILL
CHARLES LOUIS POLLARD
HERBERT MAULE RICHARDS

CONTENTS

The ferns and flowering plants of Nantucket—I . . EUGENE P. BICKNELL 49
Alabastra philippinensia—I . . . . . CHARLES BUDD ROBINSON 63
Some Echinocerei of New Mexico . . . PAUL CARPENTER STANDLEY 77
Two Bahamian species of Evolvulus . . . . . HOMER D. HOUSE 89
INDEX TO AMERICAN BOTANICAL LITERATURE. 91

PUBLISHED FOR THE CLUB

THE NEW ERA PRINTING COMPANY
LANCASTER, PA.

THE TORREY BOTANICAL CLUB

President,

HENRY H. RUSBY, M.D.

Vice-Presidents,

EDWARD S. BURGESS, PH.D. JOHN HENDLEY BARNHART, A.M., M.D.

Recording Secretary,

C. STUART GAGER, PH.D.

Botanical Garden, Bronx Park, New York City.

Treasurer,

WILLIAM MANSFIELD, PHAR.D.

College of Pharmacy,
115 West 68th St., New York City.

MEETINGS

Meetings twice each month from October to May inclusive: the second Tuesday, at 8:00 P.M., at the American Museum of Natural History; the last Wednesday, at 3:30 P.M., in the Museum Building of the New York Botanical Garden.

PUBLICATIONS

All subscriptions and other business communications relating to the publications of the Club should be addressed to the Treasurer, William Mansfield, College of Pharmacy, 115 West 68th St., New York City.

Bulletin. Monthly, established 1870. Price, $3.00 a year; single numbers 30 cents. Of former volumes, only 24–33 can be supplied separately; certain numbers of other volumes are available, but the entire stock of some numbers has been reserved for the completion of sets. Manuscripts intended for publication in the BULLETIN should be addressed to Marshall A. Howe, Editor, New York Botanical Garden, Bronx Park, New York City.

Torreya. Monthly, established 1901. Price, $1.00 a year. Manuscripts intended for publication in TORREYA should be addressed to Jean Broadhurst, Editor, Teachers College, Columbia University, New York City.

Memoirs. Occasional, established 1889. (See last pages of cover.)

Preliminary Catalogue of Anthophyta and Pteridophyta within 100 miles of New York City, 1888. Price, $1.00.

Vol. 35 No. 2

BULLETIN

OF THE

TORREY BOTANICAL CLUB

FEBRUARY, 1908

The ferns and flowering plants of Nantucket — I

EUGENE P. BICKNELL

The flora of Nantucket is marked by many features of more than ordinary interest. On this seaward island are plants which, giving expression to their insularity, have come to differ in greater or less degree from their general species. Here, too, are plants scarcely known or, indeed, known not at all elsewhere in this country. Other plants find a place in the flora of New England only by reason of their presence on Nantucket and not a few species here reach the extreme limit of their northward and eastward range or find on this island the boundary of their coastwise extension towards the south. And not in all cases do these outlying points in distribution mark merely the stop to a more or less continuous range. The occurrence of certain species on Nantucket scores a wide leap in regional position, even a separation of as much as several hundred miles or more — in one case over a thousand miles — from the nearest point where the species is elsewhere known.

These noteworthy features in the flora of Nantucket are by no means alone in giving distinction to the botany of the island. Taken as a whole and in its broader aspects the flora is replete with interest. The great abundance and wide dispersal over the island of certain species, some of them not generally common in the same latitude, will scarcely escape the most casual observation, and some of these dominant plants, especially in their flowering season, display themselves in masses and groupings of color which command the eye. Nor will the botanist fail to be impressed by

[The BULLETIN for January, 1908 (35: 1–48, *portrait*) was issued 29 F 1908.]

certain negative characters of the flora, especially the scarcity or entire absence of plants which might well be expected to occur.

The source of our knowledge of the island's general flora has been the catalogue of plants published in 1888 by Mrs. Maria L. Owen. This list brought together the few scattered facts about the botany of Nantucket made known since the first visit of a critical botanist to the island, that of William Oakes in 1829, and further gave permanent record to the discoveries of a much later generation of botanists whose explorations reached all quarters of this territory of some fifty square miles and revealed many unexpected facts. Many competent botanists and collectors thus had their part in adding to the catalogue, among whom Mr. L. L. Dame, Mr. Walter Deane and Judge J. R. Churchill have particular place. A careful study of the aquatics was contributed by Mr. Morong, Doctor C. W. Swan investigated the grasses and sedges, and Mr. F. S. Collins added a detailed report on the algae.

But the knowledge of the flora as a whole, which, twenty years ago, made possible this catalogue of Nantucket plants, was due mainly to the enthusiastic explorations and studies of Mrs. Owen, prosecuted at first, as she tells us, as a young girl and again in after years.

In the long interval since that period, with the remarkable advance it has witnessed in our knowledge of our native plants, little has been published on Nantucket botany and it is now possible to add materially to the original catalogue.

In the department of flowering plants and ferns, which is here alone considered, 656 species and varieties of Nantucket plants were enumerated by Mrs. Owen. With the additions which may now be catalogued, over 950 species can be attributed to the island. It is fully probable, however, that the actual number of flowering plants, ferns, and fern-allies belonging to this flora will be found to be well on towards 1,100, even if this figure be not finally surpassed.

The observations on which the present paper is based were made during four visits to the island as follows: Sept. 10–21, 1899; Aug. 27–Sept. 11, 1904; Aug. 4–16, 1906; Sept. 10–22, 1907. On a casual visit in August, 1889, two species were observed which were not subsequently met with.

It will be seen that my own field work has been prosecuted

only in the late summer and autumn, and there can be not the least doubt that many additional plants, especially among the sedges and grasses, would reward careful exploration in the spring and early summer.

So localized are many of the plants which grow on the island that it is not at all a matter of surprise that they were missed by the earlier explorers. I am well satisfied to believe that many additional species are to be found at the very season of my own explorations. These were carried out in much detail and it is therefore interesting to record that of the species authentically admitted by Mrs. Owen over seventy were not encountered by me. Some of these are without doubt now extinct on the island and others were introduced plants which, it appears, had no permanent foothold. On the other hand, a number of those here added, although now well established, are doubtless newcomers within recent years, while still others are clearly only adventive and may or may not take an established place in the flora.

A particular interest always attaches to the study of an insular flora. Its strictly circumscribed limits make possible some approach to completeness in achieving a knowledge of its entire composition and of apprehending such changes as may be brought about in the course of time. In the interest of comparison in the future it would seem well to express with particularity the status at the present day of each of the species known to occur on the island of Nantucket.

It is to be understood that all references to existing records are to Mrs. Owen's catalogue unless otherwise expressly stated. Additions to this earlier catalogue are denoted by an asterisk.

OPHIOGLOSSACEAE

OPHIOGLOSSUM VULGATUM L.

Border of Tom Never's swamp near the 'Sconset road, Sept. 15, 1907 — a colony of thirty or more plants almost hidden in the surrounding vegetation. The plants showed much variation — from 1.6 to 3.4 dm. in height, the leaves 2.5–6 cm. long, 7–27 mm. wide, lanceolate to elliptic-oblong and ovate-oblong, and with 9–13 basal veins. Some of the smaller plants are suggestive of Mrs.

Britton's *O. arenarium* but are nevertheless unmistakably *O. vulgatum*.

Recorded by Mrs. Owen from Polpis and Sachacha Pond, 1885 and 1886.

BOTRYCHIUM OBLIQUUM Muhl.

Occasional, usually single plants or a few together. Below the "cliff" in white sand with *Ibidium Beckii* and *Lechea maritima*; west of the town; Shawkemo; Quaise; Polpis; Squam. Sometimes under 10 cm. high with leaves only 3–4 cm. wide; largest examples 29 cm. high; ultimate segments of the leaves numerous and crowded, the stalks and their divisions bearing pilose hairs.

Recorded by Mrs. Owen from one station at the south shore in 1860 and from west of the town in 1885.

OSMUNDACEAE

OSMUNDA SPECTABILIS Willd.

Uncommon. Below the "cliff"; south and west of the town; Monomoy; Polpis; Squam.

OSMUNDA CINNAMOMEA L.

Low grounds everywhere; perhaps the most common fern of the island.

OSMUNDA CLAYTONIANA L.

Nothing was seen of this fern. The catalogue reports a single specimen from near Sachacha on the joint authority of Mrs. Owen and Mr. Dame.

POLYPODIACEAE

PTERIDIUM AQUILINUM (L.) Kuhn.

Common throughout; of large size in low thickets at Polpis and Squam.

* PTERIDIUM AQUILINUM LATIUSCULUM (Desv.) Underw.

Common. Much of the brake fern of the island is a form appearing more or less intermediate between *aquilinum* and *latiusculum*, but examples fully representative of the latter are common.

LORINSERIA AREOLATA (L.) Underw.

Locally common, especially on the eastern side of the island.

Not seen in the western quarter beyond Trot's Swamp. Much less common than the following.

ANCHISTEA VIRGINICA (L.) Presl.

Common, especially on the eastern side of the island, where in many places it forms a luxuriant growth in bog holes and wet thickets; extends into Saul's Hills. Not seen west of Trot's Swamp.

ASPLENIUM FILIX-FOEMINA (L.) Bernh.

Uncommon; Rattlesnake Bank; Watt's Run; Saul's Hills, one station; Trot's Swamp. The specimens met with were mostly of moderate size and represent no extreme form of this fern, being quite representative rather of the general species as commonly understood. Professor Underwood, to whom specimens were submitted, concurred in this view. Some examples, however, approach var. *angustum* (Willd.) Moore. As a rule the fronds are oblong-lanceolate or narrower, twice pinnate or nearly so; pinnae close-set to rather widely separated, lanceolate, spreading or ascending; pinnules crowded or well separated, linear to oblong, broadly rounded or slightly narrowed to the apex, serrate or incised, at least basally, with dentate segments; indusium short, little curved. The specimens from Saul's Hills are small and of very delicate texture. On Sept. 5, 1904, their fertile fronds were completely withered, whereas the more typical plant in Trot's Swamp was in perfect condition. Variety *Michauxii* Mett. (= var. *angustum* Moore) and "var. *rhaeticum* Moore" are both mentioned by Mrs. Owen as rare.

DRYOPTERIS NOVEBORACENSIS (L.) A. Gray.

Infrequent and local, but sometimes making an abundant growth. Common in low thickets in Polpis and in parts of Trot's Swamp; Watt's Run; one station in Saul's Hills.

DRYOPTERIS THELYPTERIS (L.) A. Gray.

Everywhere common in low grounds.

* DRYOPTERIS SIMULATA Davenp.

Frequent and locally common. Head of Tom Never's Swamp; Saul's Hills; west of Sachacha; common, often of large

size and luxuriant growth in Trot's Swamp and in wet thickets in Squam and Polpis; cranberry bog thicket near Long Pond.

DRYOPTERIS CRISTATA (L.) A. Gray.

Occasional. Open sphagnum bog by Reed Pond; near Long Pond; frequent or even common in Trot's Swamp and in Polpis thickets; near head of Tom Never's Swamp.

* DRYOPTERIS SPINULOSA (Retz.) Kuntze.

Frequent. Common and of luxuriant growth in Trot's Swamp and in boggy thickets about Polpis; head of Tom Never's Swamp; small plants on Coskaty.

DRYOPTERIS INTERMEDIA (Muhl.) A. Gray.

Occasional. Common and of large size in Trot's Swamp and in Polpis thickets; head of Tom Never's Swamp.

* DRYOPTERIS BOOTTII (Tuckerm.) Underw.

Near head of Tom Never's swamp; at several places in Trot's Swamp and in Polpis thickets, always in close association with *D. spinulosa* and *D. cristata*.

* DENNSTAEDTIA PUNCTILOBULA (Michx.) Moore.

Low open thicket near Reed Pond, forming a dense growth covering several square yards, Sept. 1907; county fair grounds under an old wooden platform; head of Tom Never's Swamp; Polpis, in a dense thicket, here, as well as in Tom Never's Swamp, associated with *D. spinulosa*, *D. intermedia*, *D. cristata*, *D. Boottii* and *D. simulata*.

ONOCLEA SENSIBILIS L.

Common throughout.

EQUISETACEAE

EQUISETUM ARVENSE L.

Apparently not very common. On and below the sandy bluff southwest of Wauwinet and on the sandy shore of Hummock Pond a low spreading form pale in color with elongated slender branches and much roughened epidermis.

* EQUISETUM FLUVIATILE L.

Sparingly on the muddy border of a pond-hole or sink ringed with a dense thicket of button-bush to the west of the monument marking Tristram Coffin's homestead — Sept. 12, 1907.

LYCOPODIACEAE

LYCOPODIUM ADPRESSUM Underw.

Frequent or rather common in damp open grounds, mostly about the borders of ponds and sandy cranberry bogs. Determined by Professor Underwood.

L. inundatum, *L.* var. *Bigelovii* Tuckerm. was not met with. The plant recorded under this name in Mrs. Owen's catalogue was doubtless *L. adpressum* which had not at that time been recognized as a species.

* LYCOPODIUM ALOPECUROIDES L.

In abundance about the shores of Tom Never's Pond and in the swamp opposite Bloomingdale, in both localities growing with *Drosera filiformis*; also about some of the ponds in Polpis. Identification confirmed by Professor Underwood.

LYCOPODIUM OBSCURUM L.

Met with only about the head of Clarke's Cove and towards the upper part of Long Pond, in both localities not uncommon. No fruiting plants seen. Reported from Gibbs' Swamp.

LYCOPODIUM COMPLANATUM L.

Monomoy; Acquidness Point; Polpis; open moorland towards the south shore; the Woods; Long Pond, Reed Pond. Less common than *L. tristachyum* and apparently fruiting only sparingly. Neither species was found in the extreme eastern quarter of the island.

* LYCOPODIUM TRISTACHYUM Pursh.

At a number of widely separated localities, sometimes fruiting freely.

ISOETACEAE

ISOETES ECHINOSPORA BRAUNII (Durieu) Engelm.

Reported by Mrs. Owen from Maxcy's Pond on the authority of Mr. Morong. No species of *Isoetes* was met with by me on the island.

PINACEAE

PINUS RIGIDA Mill.

This pine, now the most abundant and conspicuous tree of Nantucket, is said by Mrs. Owen to have all come from seed

planted in 1847 and following years. At one time its existence on the island was thought to be seriously threatened by the ravages of certain insects and the prediction was confidently made that, were not instant and extreme measures adopted for their protection, the Nantucket pines were doomed. This prophecy remains unfulfilled. To-day, although the blight of insect damage presents a dismal spectacle here and there, the pines in the main enjoy a clean and vigorous growth and have grouped themselves into close or open formations which are a very attractive feature of parts of the Nantucket landscape.

At a number of places the trees have achieved dense growths of considerable extent fairly to be described as pine woods. More often they appear in detached or straggling groves of fair-sized trees, thickets of scrub, and scattered young growth. From the pine groves about the middle of the island, outlying trees, mostly 3–5 feet high, extend all the way to the south shore, dotting the level plain for wide distances, their dark forms appearing in sharp definition against the pale stretches of beach grass (*Ammophila*) which cover parts of the plain.

East of Hummock Pond over sandy soil is a wide stretch of mingled close and open growth, strongly suggestive of parts of the New Jersey pine-barrens.

Small solitary trees have sprung up in nearly all quarters of the island, although in the extreme eastern and western sections and along the eastern side of the harbor beyond Monomoy it is nearly or quite wanting. On the eastern side a few stray trees extend towards the Shawkemo Hills, but from these hills across Saul's Hills to Gibbs' Pond and Sankaty one or two small trees only were met with. A few solitary trees were encountered in Shawkemo, none in Quaise nor in Pocomo and only a single small tree in Squam. On the western side of the island a few small trees are to be seen at wide intervals, likewise a few have extended into Madequet where, also, by a farmhouse is a small grove which was evidently planted many years ago. The most western point to which the tree has spread is beyond North Pond, where two trees about six feet high occupy an exposed spot on a high sand dune. These bore several perfectly formed but very diminutive cones, which had every appearance of maturity but were only ¾ to 1

inch in length. On some branches the leaves were equally dwarfed; other branches bore both cones and leaves of normal size. On the south side of the island many young trees have sprung up along the abandoned bed of the railroad which ran from the town to Surfside twelve years ago, the tracks having been taken up in the summer of 1895. The largest of these trees has now reached a height of seven feet as nearly as could be estimated without actual measurement.

PINUS SYLVESTRIS L.

Said by Mrs. Owen to have been planted near the head of Miacomet Pond in 1876 together with Scotch larches. There is now near the head of Miacomet Pond some rather extensive pine groves flanked with thickets of European larches, which have evidently long been left to their own undisturbed course of growth, appearing now as a wholly native feature of the vegetation. The prevailing pine of these groves is *Pinus rigida*, but mingled with this native tree are many Scotch pines both scattered and in groups, the larger trees estimated to be fifteen to twenty feet in height. That they have been slowly spreading is shown by smaller outlying trees and occasional seedlings.

These Scotch pines fruit prolifically and include several forms of distinct appearance. One of these bears ovoid cones 3.5–4.5 cm. long, the scales little thickened at the tip or the basal ones becoming umbonate. Another form has larger, narrowly ovoid-conic or tapering cones 5–7 cm. long by 2–2.5 cm. wide, the scales provided with prominent often reflexed processes. With these occurs a smaller tree characterized by very small cones only about 2 cm. long, which, when the scales spread at maturity, become broadly ovoid-subglobose and 2.5 cm. wide; the leaves are 2.5–4 cm. in length. Specimens of this tree agree closely with authentically named sheets of *Pinus Pumilio* Haenke in herb. N. Y. Bot. Garden, the cones appearing identical, although the leaves are more slender.

In 1900 a solitary tree of *Pinus sylvestris* bearing a single ovoid cone was met with in a remote spot west of Sachacha.

LARIX DECIDUA Mill.

Near the head of Miacomet Pond with *Pinus sylvestris* and *Pinus rigida* as described above and fruiting freely. The largest

trees are perhaps not over 8–10 feet in height. A considerable part of the growth is so densely massed together as to form an impenetrable thicket. Smaller trees away from the main body show some tendency of this foreigner to extend its foothold.

JUNIPERUS VIRGINIANA L.

Abundant on Coatue, extending into a long stretch of cedar-barrens towards Great Neck; scattered trees on the north shore and along the east side of the harbor; fields south of Squam towards Quidnet and west of Sachacha; scarce towards the south and southeast and wanting in most of the west and southwest quarters.

TYPHACEAE

TYPHA LATIFOLIA L.

Common. Both this species and *T. angustifolia* sometimes occur about the shores of the same pond, as at Miacomet Pond, but nowhere were the two seen actually growing together.

TYPHA ANGUSTIFOLIA L. Abundant.

SPARGANIACEAE

SPARGANIUM EURYCARPUM Engelm.

Locally common, and fruiting well; matures earlier than the two following.

SPARGANIUM ANDROCLADUM (Engelm.) Morong. (*S. lucidum* Fernald, Rhodora **9**: 87. 1907.)

A considerable and luxuriant growth fruiting abundantly in the northwest side of Maxcy's Pond, 1907. Largest fruiting heads 2.5–3 cm. in diameter; stigmas 2–4 mm. long. In a small pool east of Maxcy's Pond, which was partly filled with this bur-reed in full flower and fruit August 12, 1904, only a few sterile plants were growing three years later, its place having been taken by a dense growth of *Pontederia*. Recorded from Almanac Pond.

* SPARGANIUM AMERICANUM Nutt.

Frequent or common, occurring in nearly all quarters of the island. Much of the fruit was not mature even after the middle of September.

NAIADACEAE

POTAMOGETON OAKESIANUS Robbins.

Common; not found in flower or fruit.

POTAMOGETON PULCHER Tuckerm.

Occasional or frequent, but scarcely common and not found in flower or fruit. Both this and the foregoing were found in abundant fruit on Nantucket by Mr. Morong in 1887.

POTAMOGETON NUTTALLII Cham. & Sch.

Infrequent; brook by roadside, Polpis; Watt's Run. In flower and fruit. Recorded from Maxcy's Pond and from near Sachacha.

POTAMOGETON PERFOLIATUS L.

Common in Long, Hummock, Miacomet, and Washing ponds and fruiting freely. Leaves apparently never of large size, either remote or crowded, broadly ovate or rounded to lanceolate-oblong. Plants frequently small with numerous leaves mostly 10–15 mm. in length and densely fruited spikes only 10 mm. long. Some specimens with remote and unusually narrow leaves suggested an approach to the next.

POTAMOGETON MYSTICUS Morong.

This little-known plant was searched for unsuccessfully around the borders of Miacomet Pond, in which it was found by Mr. Morong in 1887.

POTAMOGETON PUSILLUS L.

Long, Miacomet, and Washing ponds. Fruiting freely in Miacomet Pond, August 11, 1906. Recorded also from Hummock and Reedy ponds.

POTAMOGETON DIVERSIFOLIUS Raf.

Maxcy's Pond; pool north of Trot's Swamp; pool on Nantucket golf-links; fruiting abundantly in September. Often with submersed leaves only. Recorded from Reed Pond.

POTAMOGETON PECTINATUS L.

Abundant in some of the shore ponds, often intermixed with *Ruppia maritima*. In September, 1904, a dense growth of these

two plants covered nearly the entire surface of Capaum Pond and on Sachacha Pond formed a continuous zone around the borders, extending certainly from fifty to one hundred yards out from the shore. In 1907 there was little surface indication of the plants in either pond. Both species fruit freely.

RUPPIA MARITIMA L.

Common in salt and brackish ponds and ditches. In mature fruit in the ponds, September, 1904; in a tidal ditch on Swain's Neck it was just in flower Sept. 17, 1907.

ZANNICHELLIA PALUSTRIS L.

Recorded from Hummock and Miacomet ponds and from Polpis. I did not meet with it.

NAIAS FLEXILIS (Willd.) R. & S.

Found only in a small pool on the north side of Trot's Swamp Sept. 10, 1904, the specimens bearing mature fruit. Recorded by Mrs. Owen only from Long Pond on authority of Mr. Morong.

* NAIAS GUADALUPENSIS (Spreng.) Morong. (*N. microdon* A. Br.?)

First detected Sept. 8, 1904, in Miacomet Pond, where fragments were found floating in the shallow water and cast up along the shore with other detached aquatic plants along the eastern border of the pond, the leeward side on that day. The high water roughened by a strong wind made it impossible to detect the rooted plant, nor could it be discovered in actual growth on Aug. 11, 1906, when it was found as before under conditions of wind and water almost the same.

On Sept. 14, 1907, it was discovered growing on the muddy bottom of a shallow inlet of Long Pond at the "Gut," and on Sept. 20th it was again found in Miacomet Pond, this time growing in abundance in mud and mud overlaid with sand in shallow water along the west shore. These ponds extend in a general northeast and southwest direction and each is separated from the ocean on the south shore only by a strip of sandy beach which is probably not always an effectual barrier to the sea. Miacomet is a narrow pond less than a mile long; Long Pond is over three and a half miles in length and nearly bisects the extreme western quarter of the island. The point where this *Naias* was found in

Long Pond was two thirds of a mile from the north shore and over three and a half miles from Miacomet Pond. Midway between these waters is Hummock Pond, which extends nearly three quarters of the distance across the width of the island. Here the plant was not detected although it is reasonable to suppose that it occurs throughout all three of these ponds.

In the latitude of Nantucket *Naias guadalupensis* appears to be unknown east of Nebraska although in the south it extends to west Florida. Its general range is understood to be from Oregon and Nebraska to Florida, Texas, and tropical America.

If not native to Nantucket, it has evidently long been established there and its occurrence at so great a distance from the nearest point of its known range finds no ready explanation. If the plant is susceptible of dissemination by birds, a wider dispersal in the east might be expected. It is also against the probability of its introduction by such agency that at its fruiting season the general course of bird migration is not from the direction of those regions whence the seeds might be brought. It may not be unduly fanciful to suggest the possibility of its chance introduction through the destruction of some vessel from tropic waters among the many shipwrecks which have had their scene on Nantucket shores.

The following description is from the specimens collected: Early becoming dull or brownish-green; stems 10–30 cm. long, capillary, often procumbent below and rooting at the nodes, the roots elongated and threadlike; very fragile, widely alternate-branched from the base and decompound, the ultimate divisions 3–7 cm. long; internodes of main stem 4 cm. or less in length, of the branches 5–20 cm.; leaves opposite, not at all or but little recurved, pellucid, 5–15 mm. long, 0.75–1.5 mm. wide, linear, not at all or only obscurely narrowed towards the obtuse or abruptly acute apex, minutely sharp-serrulate with numerous teeth; fruit brownish, 2.5 mm. long to the beaked style, about 1 mm. thick, linear-fusiform, sometimes slightly curved; style 0.5 mm. long, minutely bifid; pericarp obtuse at each end and strongly marked with about twenty longitudinal lines of transversely oblong rectangular reticulations; seed about 2 mm. long, under a strong light somewhat glittering from the varied reflections of the reticulations, linear, slightly narrowed to either end, the ventral side straight, the dorsal slightly curved; obscurely keeled on the ventral side towards the base.

ZOSTERA MARINA L.

Common at the western side of the island and off the north shore and often cast up along the beaches.

SCHEUCHZERIACEAE

TRIGLOCHIN MARITIMA L.

Salt marshes at Eatfire and Quaise; abundant along Bache's Harbor; dried spikes only, carpels 3.5–5 mm. long.

ALISMACEAE

ALISMA SUBCORDATUM Raf.

Pool by the railroad near the Orange Street crossing; the colony of plants is a small one and has not increased since 1889, when it was first observed. Near the Creeks, *M. L. O.*

*SAGITTARIA ENGELMANNIANA J. G. Smith.

Common in wet bogs and about the borders of ponds and showing a much wider variation in size and leaf-form than is allowed for in current descriptions: Lamina of the blade linear to ovate, 1 mm. to over 4 cm. wide, the lobes nearly parallel to widely diverging, 1 mm. to 2.5 cm. wide at base, 3–11 cm. long, tapering to an almost filiform termination. Varies greatly in its flowering period in different seasons, but appears to be generally later-flowering than *Sagittaria latifolia*. In 1904 it was in full flower in the second week of August; in 1906 at the middle of September much of it was only just in bloom; in 1899 flowers and mature fruit were found at the middle of September; in September, 1907, it was in mature fruit and no flowers were seen.

SAGITTARIA LATIFOLIA Willd.

Rare, found only in ditches along a roadway through low grounds west of the town, occurring sparingly but of the largest size. The tallest plants were 1.15 m. high, the largest leaves 1.20 m. in length, their blades 2.75 dm. long by 1.5 dm. wide at the petiole, the terminal portion rounded to broadly acute.

In full flower Aug. 7, 1906; no flowers remaining Sept. 14, 1907.

VALLISNERIACEAE

VALLISNERIA SPIRALIS L.

Common in Hummock and Miacomet Ponds, at the latter in flower and fruit Sept. 14, 1907. Recorded from Long Pond.

Alabastra philippinensia—I

CHARLES BUDD ROBINSON

During the years 1903–1905 Mr. R. S. Williams made a very extensive collection of plants in the Philippine Islands on behalf of the New York Botanical Garden. At the time a high proportion of the species represented had not yet been described; but the indefatigable work of the American botanists in the islands has since brought the most of them to light through other sources. Many still remain unpublished, however, and the present paper is intended to call attention to some of these, and to add a few miscellaneous notes upon the flora of this interesting region. All types of newly described species are in the herbarium of the New York Botanical Garden.

TAXACEAE

PODOCARPUS LATIFOLIA Bl. Enum. Pl. Jav. 89. 1827

This name should be used instead of *P. Blumei* Endl. Syn. Conif. 208. 1847, which is its indubitable synonym. *P. latifolia* Bl. is generally discarded because of *P. latifolia* Wall., but the latter was published in Pl. As. Rar. 1: 26. *pl. 30.* 1829, and this is antedated by Blume's species. *P. latifolia* R. Br.; Benn. Pl. Jav. Rar. 40. 1838, is a third and still later species.

P. latifolia Bl. is represented in this herbarium by the following Philippine numbers:

Northern Luzon: Province of Benguet, Baguio, *Williams 1035.*

Central Luzon: Province of Bataan, Lamao River, and Mt. Mariveles, *Williams 399, 624, 752, 753; Forestry Bureau* (coll. *Barnes*) *147, 194; Copeland 244; Whitford 1353.*

TYPHACEAE

TYPHA ORIENTALIS Presl, Epimel. Bot. 239. 1851

The type of this species is *Cuming 1767*, certainly from the Philippines, the locality assigned by Presl being the island of

Cebu; yet in the Pflanzenreich the Philippines are not included in its range, which is there given as northern China and Japan. Recent collections of this species are *Elmer 6382* and *8820*, both from Baguio, Province of Benguet, northern Luzon.

PANDANACEAE

FREYCINETIA CUMINGIANA Gaud. Bot. Voy. Bonite *pl. 37. f. 12–14; pl. 60.* 1843, without description.

F. luzonensis Warb. in Engler, Pflanzenreich 4[9]: 35. 1900. *F. luzonensis* Presl, Epimel. Bot. 238. 1851, in part only.

Through the kindness of Prof. Wm. Trelease, I have been able to examine a specimen of *Cuming 1455*, belonging to the Bernhardi Herbarium of the Missouri Botanical Garden. It is upon this number that *F. luzonensis* was based and Presl's description makes it evident that it contained more than one species. Comparison of the above-mentioned specimen with the descriptions indicates that it is the true *F. luzonensis* Presl, and that the *F. luzonensis* of recent Philippine botany is quite distinct. It seems desirable therefore to take up for the latter Gaudichaud's older name, which has hitherto remained unused, because originally unaccompanied by verbal description.

Pandanus glauciphyllus sp. nov.

Section Bryantia: heads solitary, ovate in outline, 4.5–5.5 cm. long, 3.5–4.5 cm. wide at base: drupes 200–300 in each head, unilocular, 1–1.2 cm. long, 6 mm. wide at the top, 4–6-sided, in dried material banded along the sides with yellow and orange, the exposed portions shining, the stigma slightly umbonate within a shallow depression.

A plant about 3 m. in height, the stem dark-gray, brown, or blackish, 25–40 cm. in diameter, with very short bracing roots, sometimes scarcely evident: leaves 0.4–1 m. long, with an extreme width of 2–2.6 cm., pale- or brownish-green above, glaucous beneath, midrib narrow, depressed above, somewhat prominent beneath, one vein on each side of the midrib conspicuous above, barely visible beneath, uniting with the midrib 1–2 cm. from the tip, the apical third of these two veins below their junction with the midrib antrorsely spinulose; midrib beneath antrorsely spinulose along apical 8–15 cm. and usually retrorsely spinulose for 1.5–6 cm. at base; leaf-margins spinulose throughout, antrorsely except sometimes near the base.

Type collected at Sax River, Province of Zamboanga, Mindanao, by R. S. Williams, *no. 2423*, in fruit, February 28, 1905.

This is closely allied to *P. polycephalus* Lam., and may be the species whose introduction into cultivation under that name is recorded by Nicholson * and by Warburg.†

SANTALACEAE

THESIUM PSILOTOIDES Hance, Jour. Bot. 6: 48. 1868

Originally described from China, but apparently well represented by *Williams 1310*, Baguio, Province of Benguet, northern Luzon; in flower, October 9, 1904. A genus not previously known in the Philippines.

NYCTAGINACEAE

PISONIA LONGIROSTRIS Teijsm. & Binnend. Tijdschr. Nederl. Ind. 25: 401. 1863

Collected on the island of Jolo, by R. S. Williams, *no. 3125*; in flower, July, 1905. Not previously reported from the Philippines.

RANUNCULACEAE

Thalictrum philippinense sp. nov.

Flowers probably perfect; certainly every young flower seen perfect, older ones on same or different plants lacking stamens and sepals: inflorescence a terminal 2–5- (usually 2- or 3-) flowered sessile cyme, simulating a panicle; pedicels slender, 1–5.5 cm. long; sepals 5, petaloid, 2.5–3.5 mm. long, 3-nerved, elliptic, cuneate at the base, obtuse at the apex, deciduous: stamens 25–35, early deciduous, 7.5 mm. long, the basal half of the filaments very slender, the upper half clavate, the anthers 0.5 mm. long, elliptic: maximum number of carpels seen 12, stipitate, at anthesis 5–6 mm. long, of which the stipe forms 2 mm. and the style 1 mm.: achenes including the stipe also 5–6 mm. long, 3-ribbed on each side, tipped by the persistent style.

A glabrous plant, 20 to 30 cm. high, with a rootstock only 3–5 mm. in length and somewhat tuberous roots: basal leaves on slender petioles 6–15 cm. long, 2–3-ternate, ultimate leaflets with petiolules 2.5–10 mm. long, the lateral leaflets 8–16 mm. long, orbicular-ovate in outline, rounded or truncate or subcordate at the base, 3-lobed, the lobes also usually notched, rounded or truncate

* Ill. Dict. Gard. 3: 18. 1878.

† Das Pflanzenreich 4[9]: 69. 1900.

or retuse at the apex, the terminal leaflets similar, slightly larger, upper leaves few, shorter-petioled, or the uppermost nearly sessile, similar to the basal but once or rarely twice ternate.

Type collected on steep shaded cliffs, near Baguio, Province of Benguet, northern Luzon, by R. S. Williams, *no. 1137*, in flower and fruit, June 22, 1904; also represented by *Williams 957*, from the same locality, in fruit, September 18, 1904.

ANNONACEAE

Anaxagorea radiata sp. nov.

Glabrous throughout: flowers single or less frequently in pairs, terminal upon leaf-bearing branchlets: carpels 12 to at least 20, radiately arranged, slightly scabrous, their stipes 1.5–2.2 cm. long, 1–1.5 mm. wide at the base, very gradually widening upwards, body of carpels 1.2–1.3 cm. long, 8–10 mm. wide, obliquely oval or almost spheric before dehiscence, longitudinally striate within except upon a thickened area near the apex; this area 6 mm. in diameter, somewhat irregular in outline, its outer edge or edges nearly parallel to the dorsal suture; carpels dehiscing along both sutures: seeds 2, collateral, 1.2–1.3 cm. long, 8 mm. wide, obovate, apiculate, flattened where pressed together, jet-black or amber-black, shining.

A shrub 2.5 m. high; bark of branchlets gray, roughened or striate: leaves petioled, elliptic to oblong, 9–16 cm. long, 4–7 cm. wide, acute or rounded at the base, obtuse or more often obtusely acuminate at the apex: the more conspicuous primary veins 6–8 on each side, with intervening ones often nearly as prominent, loosely arched-anastomosing and forming two submarginal veins.

Type collected by R. S. Williams, *no. 3108*, near the base of Mount Dajo, island of Jolo; in mature fruit, July 27, 1905.

Very similar in general appearance to *A. javanica* Blume, but easily distinguished by the terminal inflorescence and the more numerous carpels.

Cyathocalyx acuminatus sp. nov.

Flowers fascicled on short lateral branches not opposed to leaves, usually 3–7 in each fascicle, borne on slender, straight pedicels 1.5–2 cm. long; pedicels and perianth ferruginous-tomentose: sepals 3, semicircular, 1.5–2 mm. long, 3 mm. wide at base: petals 6, yellowish-green, fragrant, valvate, in two rows, nearly equal in length, 2–2.2 cm. long, the basal 3 mm. of those

of both rows closely arching over the stamens and carpels; apex of the hood white-tomentose within; hooded portion of outer petals about 5 mm. wide, upper portion of outer petals 2.5 mm. wide at the base, 3–3.5 mm. wide in the middle, tapering to an obtuse apex; inner petals subsimilar but narrower, the hood 3.5 mm. wide, base of upper portion 1.5 mm. wide, middle of upper portion 1.5–2 mm. wide: stamens about 40, 1–1.5 mm. long, the anther-cells concealed above by the connectives: carpels about 10, at anthesis 1 mm. long, yellowish-tomentose; mature carpels red, in all 1.5–2.5 cm. long, borne on stipes 4–7 mm. long, the body of the carpel 1–1.2 cm. wide; carpels with 1–3 transverse constrictions without, corresponding to as many divisions within, each 1-seeded; seeds therefore 2–4, obovate-orbicular in outline, 1 cm. long, 8 mm. wide, testa chestnut-brown, shining.

A small tree, about 7.5 m. high, and 7.5 cm. in diameter, with gray to blackish, striate bark, ferruginous-tomentose to glabrate: leaves borne on petioles 1–2 cm. long, chartaceous, elliptic or oblong, acute or somewhat rounded at the base, acuminate at the apex, in all 14–23 cm. long, 5–7.5 cm. wide, with pubescent petioles, midribs, and veins; primary veins usually 10 on each side of the midrib.

Type collected at Sax River, Province of Zamboanga, Mindanao, at an elevation of above 75 m., by R. S. Williams, *no. 2143*, in flower and fruit, February 8, 1905. Closely allied to *C. biovulatus* Boerl., from Borneo.

Mitrephora Merrillii nom. nov.

M. ferruginea Merr. Bur. Govt. Lab. Publ. **17**: 16. 1904, in part. Not *M. ferruginea* Boerl.; Koord. Meded. 's Lands Plantentuin **19**: 335. 1898.

As already pointed out by Merrill this species was originally confused by him with the very similar *M. Lanotan* (Blanco) Merr., from which it is distinguishable by having leaves more numerously veined, elliptic or narrowly elliptic instead of linear-oblong, and densely ferruginous-pubescent carpels 3.5–4 cm. long.

All specimens seen of this species are from Lamao River and Mount Mariveles, Province of Bataan, Central Luzon: *Williams 111; Merrill 3728; Merrill, Decades Philipp. Forest Flora* (coll. *Borden*) *166; Elmer 6734, 7000; Forestry Bureau 61, 367, 513* (coll. *Barnes*), *2045* (coll. *Borden*), *2829* (coll. *Meyer*).

Mitrephora Williamsii sp. nov.

Flowers fragrant, striped red and yellow, fascicled in condensed cymes, opposite the leaves, apparently unisexual, only male flowers seen: pedicels 5–8 mm. long, 2 mm. in diameter, covered with brownish tomentum, as are also the outer sides of the sepals and the outer row of petals: sepals 3, separated nearly to the base, broadly ovate, shortly and obtusely acuminate, 5–6 mm. long, 4 mm. wide at the base: petals of outer row 3, valvate in bud, similar in shape to the sepals but much larger, being 1.3–1.5 cm. long, 9–10 mm. wide at the base; inner petals 3, very dissimilar to the outer in shape, consisting of a claw 1 cm. long and 2 mm. wide, its width nearly constant throughout, bearing a rhomboid-orbicular hood 6–7 mm. long and 7.5 mm. wide, the inner surface of the hood ferruginous-tomentose and forming about 7 longitudinal folds: stamens numerous, 200–250, 0.8–1 mm. in length, the anther-cells covered at the apex by the connective.

A small tree 12 m. high, having a trunk 12.5 cm. in diameter: bark of ultimate branches dark-gray or black, longitudinally striate, the younger portions somewhat ferruginous-tomentose, becoming glabrate: leaves borne on stout petioles 12–18 mm. long, and 2.5–4 mm. thick, ovate, acute at the base, gradually narrowed above to an obtuse apex or barely acuminate, 20–32 cm. long, 7–11.5 cm. wide, the upper surface somewhat olive-green, glabrous, shining, the under surface brownish-green, slightly ferruginous-pubescent on the midrib and primary veins; midrib and primary veins immersed above, conspicuous beneath, primary veins 20–25 on each side of midrib.

Type collected at Sax River, Province of Zamboanga, Mindanao, by R. S. Williams, *no. 2188*, in flower, March 3, 1905.

Polyalthia clusiflora (Merr.)

Unona clusiflora Merr. Bur. Govt. Lab. Publ. **35**: 13. 1905.

Examination of several collections of this species showing that the carpels each contain a single ovule, attached at the very base of the carpel, it is necessary to transfer it to the section *Monoon* of *Polyalthia*.

Widely distributed in the Philippines, being known from Luzon, Leyte, and Mindanao.

Uvaria rubra sp. nov.

Flowers hermaphrodite, solitary on leaf-bearing branches, but not opposed by leaves: pedicels and calyx ferruginous-tomentose;

torus globose in fruit, flattened on top in flower; calyx in bud separated into lobes only at the tip, ultimately 2- or 3-lobed, semi-orbicular, lobes about 2.5 cm. long and 3 cm. wide across middle, shortly and obtusely acuminate: petals dark-red, 6, in two rows, subequal, imbricate in bud, coriaceous, narrowly to broadly elliptic, 3.5–4.4 cm. long, 1.7–2.4 cm. wide, attached by 5–6 cm. of their bases, rounded at the apex: stamens 200–250, 7 mm. long, 1 mm. wide, the anther-cells covered at the tip by the connectives: carpels about 100, when nearing maturity about 4 cm. long and 8 mm. in diameter, nearly cylindric, apiculate, ferruginous-tomentose, rarely (and then only slightly) constricted, their walls granular; ovules few (12).

A low bush or sometimes climbing over trees, its stems 1.5–2 cm. in diameter, with light- to dark-gray bark, scaly becoming striate; ferruginous-tomentose on the younger parts, becoming glabrous: leaves 15–32 cm. long, 5–12.5 cm. wide, borne on petioles 3–8 mm. long, elliptic-obovate, rounded or acute or sharply acuminate at the apex, cordate at the base, bluish-green above, paler and reddish-veined beneath, glabrous except on the midrib and primary veins of the upper surface; primary veins on each side of the midrib 15–20.

Type collected at Santa Cruz, Province of Davao, Mindanao, by R. S. Williams, *no. 3042*, in flower, June 29, 1905: also represented by *Williams 3027* from the same locality, in fruit, July 11, 1905.

Very similar in its vegetative aspect to *U. scandens*, but at once distinguishable by the entirely different inflorescence and the larger flowers.

Uvaria scandens sp. nov.

Flowers hermaphrodite, borne in short cymes or rarely singly, upon short, fascicled, warty, suberose branches from leafless portions of the stem, the inflorescence throughout ferruginous-tomentose: pedicels at anthesis 8–10 mm. long, bracteoles orbicular-ovate, somewhat clasping: torus depressed-hemispheric; calyx undivided in bud except at the extreme apex, gradually splitting, at first leaving only a triangular or semilunar opening, until at anthesis the 3 or rarely 4 lobes are separated to within 2.5 mm. of the base; calyx-lobes suborbicular, broadest a little below the middle, 8–10 mm. long, 9–10 mm. wide: petals imbricate in bud, subequal, broadly oval or ovate, all ultimately spreading, 13–15 mm. long, 10–11 mm. wide: stamens about 500 in number, 1.7–1.8 mm. long, the anther cells covered at the apex by the connective:

carpels 50 or more, stellate-tomentose, at anthesis about 3 mm. long, enlarging later, each containing 8–10 ovules: fruit not seen.

Climbing and twining over trees, its stems 5–6 cm. in diameter, wood yellowish, bark of older portions light- to dark-gray, somewhat furrowed, bark of younger branches yellowish-gray, scaly, elongating into furrows, younger portions ferruginous-tomentose, becoming glabrous: leaves borne on petioles 3–7 mm. long, elliptic to obovate, subcordate to acute at the base, somewhat abruptly contracted at the apex into an acumen 1.5–2 cm. long in mature leaves, 15–25 cm. long, 7.5–9.5 cm. wide, bluish-green above, paler beneath, glabrous above except upon the somewhat immersed ferruginous-pubescent midrib and primary veins, minutely tomentose beneath; primary veins 12–15 on each side of the midrib, oblique, arching near the margin, secondary veins anastomosing, somewhat conspicuous.

Type collected at Santa Cruz, Province of Davao, Mindanao, by R. S. Williams, *no. 2764*, with flowers in all stages, May 5, 1905.

SABIACEAE

Sabia philippinensis sp. nov.

Flowers green, small, in terminal or subterminal compound cymes: pedicels slender, 2–4 mm. long, calyx about 1.2 mm. long, united for about three-fourths of its length, its lobes 5, ovate, obtuse: petals white, 5, opposite the calyx-lobes, and exceeding them in length: stamens 5, opposite the petals and calyx-lobes, about 1 mm. long, comparatively thick: ovary 1, exserted: fruit baccate, 1.5 cm. long and nearly 1 cm. in diameter, tipped by the persistent stigma, 2-celled.

A glabrous woody vine, with stems over 6 m. long and 1–1.5 cm. in diameter, climbing over trees: the older parts of the stem with light-gray bark, young shoots zigzag with striate yellowish-green bark: petioles 6–10 mm. long, slender, grooved on the upper surface; leaves alternate, entire, or somewhat wavy on the margins, olivaceous on the upper surface, green beneath, lanceolate or oblong-lanceolate, acute at the base, acute or acuminate and usually mucronate at the apex, primary veins on each side of the midrib about 12, arched-anastomosing, secondary and tertiary venation also conspicuous especially beneath, one or two submarginal veins present.

Type collected near Baguio, Province of Benguet, northern Luzon, by R. S. Williams, *no. 1445*, with young flowers and fruit, November 8, 1904.

This genus has not hitherto been reported from the Philippines. This species is closely allied to *S. Swinhoei* Hemsley, from Formosa, but seems to be distinguished by constantly narrower and much more attenuate leaves. The flowers described above were hardly sufficiently mature.

ELAEOCARPACEAE

Elaeocarpus venosus sp. nov.

Flowers racemed in the axils of the upper leaves; racemes 8–12 cm. long, the rachises 2–2.5 mm. in diameter, angled, together with the peduncles ferruginous-silky-tomentose; flowers usually 6–12 on a raceme, pedicels spreading or more often decurrent, 1.6–1.8 mm. in diameter, at anthesis 8–10 mm. long, each subtended by an ovate to obovate bract 8–12 mm. long and 7–8 mm. wide; flower-buds ovate; calyx-lobes 5, lanceolate, when mature 12–12.5 mm. long, separated for about four-fifths of their length, coriaceous, subacute at the apex, densely ferruginous-tomentose without, within less markedly pubescent but conspicuously 3-nerved: petals 5, obovate, truncate at base, fimbriate to a depth of 1–4.5 mm. at the rounded or truncate apex, 1–1.4 cm. long, 2.5–3 mm. wide at the base, 6–7 mm. wide at the apex, densely silky-tomentose: stamens about 60, linear, very minutely antrorsely barbed, 5–6 mm. long, the filaments 1–1.5 mm. long, the anther-tips free, acute, sometimes recurving: ovary sessile, densely golden-brown, silky-tomentose, globose, 3.5–4 mm. in diameter, 3-celled with 6–8 ovules in each cell: fruit blue, drupaceous, glabrous, oval, 2.3–2.7 cm. long, 2.1–2.2 cm. in diameter; stone 2.1–2.4 cm. long, 1.6–1.7 cm. in diameter, villose and variously channeled without, 3-celled, each cell with one seed.

A tree 9 m. high and 15 cm. in diameter: bark dark- or brownish-gray, furrowed, marked by the scars of fallen leaves, nearly glabrous: leaves stiff, coriaceous, alternate, borne on petioles 7.5–12 mm. long and 2.5–3 mm. wide, elliptic-obovate, entire, the margins revolute, acute or somewhat rounded and more or less decurrent at the base, truncate or rounded or rarely shortly and obtusely acuminate at the apex, glabrous and shining above, when young tomentose beneath, becoming glabrous; veins reddish on the upper surface, yellowish or whitish beneath, midrib raised above both surfaces except the tip of the upper, primary veins immersed in the upper surface but projecting from the under, these and the secondary and tertiary veins very conspicuous beneath; primary veins 10–12 on each side of the midrib.

Type collected on Mount Santo Tomas (Tonglon), province of Benguet, northern Luzon, by R. S. Williams, *no. 2002*, in flower and fruit, November 29, 1904. A species closely allied to *E. tuberculatus* Roxb., but distinguished by its 3-celled ovary, differently veined leaves, and otherwise.

THYMELAEACEAE

Daphne luzonica sp. nov.

Flowers pale-yellow, solitary or few, terminal, borne on peduncles 2–3 mm. long, trumpet-shaped, 13–14 mm. long, the receptacle and calyx two-thirds and one-third respectively of this length: sepals 4, lanceolate, obtuse at the apex, ciliate especially at the apex: petals none: stamens 8, in two rows: anthers subsessile, linear-oblong, 1.5–2 mm. long, dehiscing longitudinally: ovary superior, without special "receptacle-figuration" at the base, at anthesis 3.5 mm. long, 1.5 mm. wide, 1-celled, 1-ovuled; stigma sessile, 2-lobed: fruit unknown.

A slender bush, 1.5 m. high, with brownish, striate bark, or darker on the youngest shoots: glabrous except at the ends of the branchlets: leaves on petioles 2–4 mm. long, alternate or crowded at the ends of the branches and then nearly opposite, coriaceous, brownish above, at least on dried specimens, pale beneath, elliptic, cuneate at the base, retuse at the apex, 6.5–8.5 cm. long, 1.6–2.1 cm. wide, entire, primary veins on either side 6–8, irregularly anastomosing.

Type collected near the summit of Mount Santo Tomas (Tonglon), Province of Benguet, northern Luzon, by R. S. Williams, *no. 1535*, in flower, November 29, 1904.

This species is very closely allied to *Henry 11,321*, from Mengtse, Yunnan, China, as yet unnamed. The genus is not hitherto recorded from the Philippines.

MELASTOMATACEAE

Sarcopyramis delicata sp. nov.

Flowers solitary, terminal, borne on peduncles 3–5 mm. long, surrounded by and at anthesis overtopping a whorl of bracts usually similar to the leaves but smaller: calyx-tube triangular-hemispheric, about 5 mm. long, its margin at first gradually but finally abruptly contracted into 4 lanceolate lobes 1.5 mm. long, and each bearing 2 or 3 whitish hairs also 1.5 mm. long: petals 4,

11–14 mm. long, pink-lilac, oblong or obovate, shallowly 3-lobed at the apex, acuminate, apiculate: stamens 8, alike, about 2.5–3 mm. long, the filaments somewhat dilated towards the base, anthers 0.6–0.7 mm. long, elliptic-obovate, obcordate, downward prolongation of the connective very short: style 4 mm. long: fruit unknown.

A slender herb, simple or sparingly branched, erect or somewhat prostrate, 6–15 cm. high; stem winged above, angled below: leaves membranaceous, opposite, ovate, obtuse and mucronate at the apex, acute to rounded at the base, variable in length, attaining 3 cm. inclusive of the slender 4–5 mm. long petioles, 3-nerved, dentate-ciliate on the margins, and with one or rarely two rows on each side of the midrib of whitish hairs exceeding 1 mm. in length and about 2 mm. apart.

Type collected by R. S. Williams, *no. 1276*, on Mount Santo Tomas, Province of Benguet, northern Luzon, in flower, July 1, 1904; also at the same locality, *no. 1350*, October 12, 1904; also represented by *Elmer 8806*, Baguio, Province of Benguet. Mr. Merrill has already reported it from Mount Halcon, Mindoro, and has further supplied me with the following additional data regarding its occurrence in northern Luzon: *4809 Merrill*, Pauai, 30 miles north of Baguio, Province of Benguet, mossy forest at 6800 ft.; *4608, 4491 Merrill*, Mount Data, Province of Lepanto, on earth, prostrate logs and mossy tree-trunks, in mossy forests at 7000 ft.

CLETHRACEAE

Clethra Williamsii sp. nov.

Inflorescence a terminal panicle, composed of 7–12 racemes, 15–20 cm. in length, all its branches, the bracts, pedicels, and calyx densely covered with gray tomentum interspersed with very frequent, rust-colored, stellate hairs 1 mm. or less in length, the latter scantily developed on the pedicels, but dense on at least the margins of the calyx-lobes: pedicels about 3.5 mm. long, slender, broadest at the base, tapering to the apex, ascending or spreading, bracts linear, 4 mm. long, not early deciduous: calyx about 3 mm. long, its lobes 2 mm. long, ovate, obtuse at the apex: corolla-lobes broadly oval to suborbicular, 3–4 mm. long, 2.5 mm. wide, broadest at the middle; stamens nearly equaling the corolla, the anthers diverging above: ovary also tomentose; style becoming exserted, expanded at the slightly three-lobed stigma.

A tree, about 9 m. high and 12.5 cm. in diameter; bark of

upper branches ashen; ultimate branches angled, rusty-tomentose: leaves alternate, or at the extremities of the branches verticillate, the petioles 1–1.7 cm. long, tomentose; young leaves elliptic, mature ones bluish-green above, dull-green beneath, 10–13 cm. long, 3.75–4.75 cm. wide, broadest a little above the middle, slightly inequilateral, elliptic to elliptic-obovate, cuneate at the base, acute at the apex, sharply but somewhat coarsely serrate except at the base, serrations callous at the tips, midrib and veins on upper surface canaliculate, tomentose, on lower surface very prominent, appressed-tomentose, reticulations also prominent.

Type collected on Mount Apo, Mindanao, at an elevation of 2,100 m., by R. S. Williams, *no. 2596*, in flower, March 31, 1905. Native (Bogobo) name: Cal yar pe.

In order to meet the requirements of the Vienna Rules, Latin diagnoses are appended of the species believed to be described herein for the first time.

Pandanus glauciphyllus: capitulis solitariis, ovatis; drupis permultis, unilocularibus, nitidis; foliis metralibus, subtus glaucis.

Thalictrum philippinense: floribus hermaphroditis, cymis paucifloris, sepalis petaloideis, ellipticis, carpellis stipitatis.

Anaxagorea radiata: floribus solitariis vel rarius geminis, terminalibus; carpellis plerisque, radiantibus, stipitatis, seminibus duobus, collateralibus.

Cyathocalyx acuminatus: floribus in ramis brevibus non foliis oppositis fasciculatis; petalis infra arcuatis, staminibus brevibus, antheris connectivo subditis; carpellis maturis rubris, stipitatis, 2–4-locularibus.

Mitrephora Williamsii: floribus in cymis foliis oppositis fasciculatis, masculinis tantum visis; petalis valvatis, exterioribus sepalis similibus, interioribus dissimilibus; staminibus numerosis.

Uvaria rubra: floribus solitariis, hermaphroditis, petalis similibus, imbricatis, ellipticis, rubris; staminibus carpellisque multis, his cylindraceis, apiculatis.

Uvaria scandens: floribus hermaphroditis, cymosis vel rarius solitariis; petalis imbricatis, similibus; staminibus numerosis; carpellis plerisque.

Sabia philippinensis: floribus parvis, cymosis, terminalibus vel subterminalibus: calycis segmentis, petalis, staminibusque oppositis; bacca biloculari.

Elaeocarpus venosus: floribus racemosis; petalis obovatis, fimbriatis; ovario globoso, triloculari; fructu drupaceo.

Daphne luzonica: floribus solitariis vel saltem paucis, terminalibus; sepalis lanceolatis; petalis nullis; ovario uniloculari, uniovulato.

Sarcopyramis delicata: floribus solitariis, terminalibus; petalis oblongis vel obovatis; staminibus similibus, connectivo brevissime prolongato.

Clethra Williamsii: floribus terminalibus, paniculatis; calycis segmentis ovatis, obtusis, corollae segmentis ovalibus vel suborbicularibus; foliis ellipticis vel ellipticis-obovatis, serratis.

NEW YORK BOTANICAL GARDEN.

Some Echinocerei of New Mexico

Paul Carpenter Standley

Among the commonest of the cacti that grow in the southern part of New Mexico are the scarlet-flowered *Echinocerei*. They are abundant upon the sandy mesas that lie above the valley of the Rio Grande and are frequently seen in the mountains that rise here and there above the mesas. They are never found in the valley of the river. To a botanist observing the plants it is evident that a number of different forms are represented, for the plants vary noticeably in habit, size, length and color of spines, and color and size of flowers.

The writer spent some time during the spring of 1907 in a study of these forms in an attempt to see how many species might be represented or whether all the forms found might not be modifications of one extremely variable species. The material for this study consisted of something over a thousand separate plants growing in the cactus garden of the New Mexico Agricultural College. These plants were collected mostly upon the mesa lying between the Rio Grande valley and the Organ Mountains. A few were brought from the Organ Mountains. Several plants from the type locality of *Echinocereus coccineus* were also examined. In addition to this living material, examination was made, through the kindness of Dr. William Trelease, of the Missouri Botanical Garden, and Dr. B. L. Robinson, of the Gray Herbarium, of the dried material in the herbaria of these institutions, including the type material of the three species here discussed. In addition to the types a number of other interesting specimens collected by the early botanical explorers, some of them in this same region, were examined.

As soon as the plants began blooming, about the middle of March, the study of them was begun. Measurements were made of over a thousand plants. These measurements included size and habit of plants, number of ridges, number and arrangement

of spines in the areolae, length and color of spines, size and color of flowers, shape of petals, length of stamens, number and color of stigmas, and several less important details. These measurements were continued as the different plants came into flower, until a freeze the twenty-sixth of April killed all the flowers and buds. On account of this freeze it was impossible to make any study of the fruits, characters of which may be of value in separating the species.

A number of species, all of them separable with difficulty, have been named in this group of *Echinocerei*. After some study of the type materials the writer decided that three reasonably distinct species were represented by the material in the garden, *E. polyacanthus* Engelm., *E. coccineus* Engelm., and *E. conoideus* Engelm. In order to facilitate a comparison between these three species, after careful study of the plants as a whole, a selection was made among the plants in the garden of one hundred individuals to represent each of the three species. The plants selected were those considered to be most typical of the species and were easily separated from the others and from each other, although there were many plants in the garden that it would have been difficult to refer to any of the species with any degree of certainty. Here there was obviously room for error, but this must always be the case in any determination of species. These three lots of plants are those hereafter referred to as *E. coccineus*, *E. polyacanthus*, and *E. conoideus*.

The measurements of these selected plants, together with the measurements of the entire lot, were then tabulated and an attempt made at a graphical statistical study of them. Curves were plotted illustrating the variation in each lot and a comparison was made of the four sets of curves in order to see whether any of the characteristics exhibited by any one lot of plants were peculiar to that species alone. The results were rather disappointing. Out of the whole number of living plants studied it was impossible to distinguish more than four species, while any one glancing over the plants and noting the great variation in color and size of spines and flowers would have guessed that at least a dozen distinct forms were represented. There is even some doubt whether at least three of these so-called species may not be forms of a single species.

The greatest difficulty encountered was the finding of some constant character or group of characters by which to differentiate the species. The extremes of variation of a given character upon any single plant were farther apart than the means of the same character for two adjacent species. Neither was there any concurrent variation of characters found. Instead, intergrading forms can almost always be found between any two extremes of a given character. *E. polyacanthus*, for instance, seems to possess forms of spines that connect or lie midway between those of *E. coccineus* and *E. conoideus*. Careful study was made of the arrangement of the spines, color and shape of flowers, and stamens, and stigmas, in the hope that some character would be found which would be constant in one form, but no such peculiarity was found, with the possible exception of the spines. The curves showing graphically the variation of separate characters, when compared, showed plainly (1) the lack of concurrent variation, (2) the presence of intergrading forms, and (3) the overlapping of certain characteristics in the selected lots of plants. The different distinguishable characters were combined in almost every imaginable way upon the different plants in the most bewildering manner.

The best characters by which to separate the plants are probably those of the spines, taking them as a whole. Their stoutness, length, color, and arrangement furnish a means of distinguishing some of the forms, although even this is far from being a satisfactory one. In the plant which is our conception of *E. coccineus* the spines are light-colored, usually white or straw-colored; they are comparatively short and slender. In *E. conoideus* they are very long and slender; in most cases they are somewhat angled and more or less deflexed; their color is darker than in *E. coccineus* although it varies considerably in different plants. In *E. polyacanthus* the spines are midway in length between those of *E. coccineus* and *E. conoideus*, usually much longer than those of the former species and frequently as long as those of the latter; the spines are stouter than those of the other two species, and are ordinarily terete, rarely somewhat angled near the base; the color is quite variable, ranging from almost white to dark-gray or almost black; the spines, too, are more abundant, covering the plant more closely. The arrangement of the spines seems to be the same in all three species.

In many of the descriptions of this group the color of the spines is given as white, changing to ashy-gray or dark-gray. No such change was observed in any of the plants examined. Indeed, the young spines are often darker in color than the older ones. The spines at the base of the plant are frequently discolored by soil and water and this may have been the foundation for the statements in the descriptions mentioned.

The spines in these *Echinocerei* occur in areolae along the ridges of the plant. The arrangement of the spines in the areolae varies slightly in different plants and sometimes in the same plant. There are usually four central spines, sometimes more, which are commonly longer than the others. Around these, about the edge of the areola, are a number of radials. For convenience I have divided these into three groups. At each side of the areola are three or four long spines which I have called laterals. Above these are two or more very small spines which are often deciduous with age; these are the superior radials. Below the laterals are three or four spines, longer than the superior ones, which may be called inferior radials.

In the whole lot of plants examined the length of the central spines ranged from 14 to 81 mm. The length in the majority of cases lay between 20 and 40 mm. Even on a single plant there may be a remarkable variation in the length of the centrals. On a plant of *E. coccineus* the centrals, 102 in all, were measured. The length varied from 12 to 40 mm. with the chief mode of the curve at 24 mm. On a plant of *E. conoideus* it would be possible to find an even greater variation in length.

The length of the superior radials in the entire lot of plants ran from 4 to 22 mm. The greatest maximum was at 8 mm. The number of spines exceeding 13 mm. in length was very small. In *E. coccineus* the variation was from 5 to 13 mm.; in the other two species the length varied from 5 to 18 mm.

The length of the lateral radials ranged from 8 to 35 mm., with the principal modes of the curve at 18 and 21 mm. In *E. coccineus* the lengths varied from 10 to 24 mm., with modes at 16 and 20 mm.; in *E. polyacanthus* from 10 to 27 mm., with modes at 15 and 19 mm.; and in *E. conoideus* from 11 to 32 mm., with modes at 17, 20, and 24 mm. These lateral spines, as well as the

other radials, are sometimes reflexed rather closely against the ribs of the plant, and in other cases more spreading. This character, however, seems to have no constancy.

In the inferior radials the length was from 9 to 36 mm., with the chief mode of the curve at 15 mm. In *E. coccineus* the length ranged from 9 to 23 mm., with modes at 13 and 16 mm.; in *E. polyacanthus* from 10 to 28 mm., with modes at 15 and 19 mm.; and in *E. conoideus* from 10 to 31 mm., with the main mode at 20 mm.

The distances between the areolae and between the ribs were measured because the apparent spininess of the plant is largely dependent upon these distances. It depends not upon either alone, but upon both taken together. The areolae may be very close to each other but the plant does not appear densely spiny because of the distance between the ribs and vice versa. The length of the spines, of course, is of importance in producing this effect of spininess. No satisfactory results were obtained from these measurements. As a rule, plants of *E. polyacanthus* seem more spiny than those of either of the other two species, and *E. conoideus* rather more so than *E. coccineus*.

The number of ribs is not important for it seems to vary equally in all three species. On a single plant on different branches the number of ribs sometimes varies from ten to twelve. Ten is the most common number.

The length of the flowers ran from 39 to 90 mm. The largest flowers were observed on plants of *E. conoideus*; but the number of plants with large flowers was small, so that this is probably not necessarily characteristic of the species. The size of the flowers depends somewhat upon the amount of water the plant receives. The plants that had been recently transplanted and had not received so much water as the others, produced flowers that were noticeably smaller.

The shape of the flowers is not the same on all plants. On some the flower is long and trumpet-shaped, gradually widening outward; on others the petals and sepals spread abruptly from about the middle of the flower. The shape of the petals, too, varies. In about forty flowers out of seven hundred the petals were retuse at the apex. In the others the apices were broadly

obtuse. In some cases the petal narrows very gradually from the apex toward the base; in others the petal is very broad near the apex and narrows abruptly near its middle, giving it a broadly spatulate outline. The petals measured ranged in width from 6 to 21 mm. The number of petals is subject to some variation: there are usually from two to three complete whorls of the perianth, but in some flowers one finds about four, and in others scarcely more than a single whorl.

The flowers exhibited quite a range of color. In most specimens the upper part of the petal is deep-scarlet or orange-scarlet of various shades (RRO to RO1 and RO2, Prang Color Chart.) The color of the base of the petals is much lighter, yellowish-white, pale-yellow, greenish-yellow, pale orange-scarlet, rosy-white, or even pure-white. Other flowers have the upper part of the petals of a rose-color, passing into white at the base. Many of the flowers that are at first orange-scarlet or deep-scarlet become rose after a few days; but others are rose-colored when the flowers first expand. In a few flowers there was a decidedly purplish tint but this is rare. These color characters seem to vary without any relation to the other characters of the plants.

The number of the flowers upon the plant varies but little. The taller plants usually have a larger number of flowers than the smaller ones. In the three older species the flowers are lateral, mostly produced near the summit of the plant, each from the upper side of an areola. In the new species the flowers usually appear abundantly all over the plant, even from near the base.

The plants of these species are cespitose in habit, having anywhere from one to ten branches. Larger plants are rare. The mountain form, *E. coccineus*, is usually found as a plant of only a few stems. Sometimes, however, plants of this species form large hemispherical masses consisting of more than a hundred stems.

The length of stamens varies in different plants, seemingly without regard to the other characteristics of the plant. In some flowers the stamens are hardly more than half as long as the style; in others they are only a little shorter than the style, while in most of the flowers they reach about to the stigmas. In a few flowers the stamens were even longer than the entire pistil. The color of the stamens is about the same in all cases, the anthers a deep

rose-purple, the filaments white, sometimes rose-colored near their junction with the anthers.

The number of stigmas is ordinarily eight, nine, or ten. Sometimes it is as low as four or five, while again it may reach thirteen. The color of the stigmas is usually a dull yellowish-green, but in some plants it is a bright chlorophyl-green. Sometimes the stigmas are long and slender; stigmas of this kind are usually yellowish-green; when they are short, they are thick and stout and the color is more likely to be bright-green.

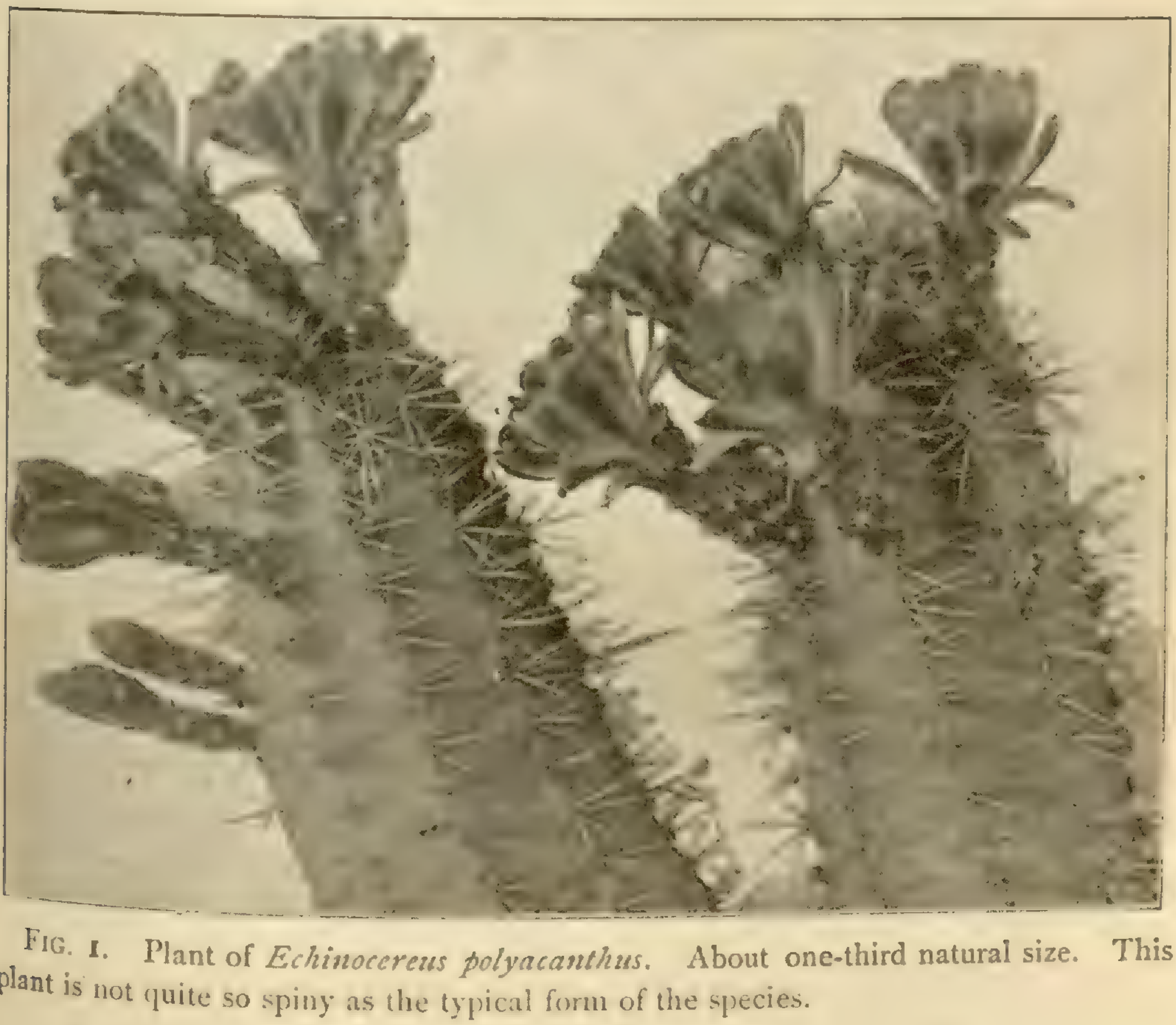


FIG. 1. Plant of *Echinocereus polyacanthus*. About one-third natural size. This plant is not quite so spiny as the typical form of the species.

In the beds composed of these three species several plants were noticed, which on account of the color of their spines, number and arrangement of the spines in the areola, and shape and size of flowers, were quite different from any one of the three species discussed here. They seemed rather to belong to some other group of *Echinocerei* although on closer study they were found to be as closely related to this group as to any other. After careful examination these plants seemed to be worthy of description as a new species and a description is added here. There also follows

a discussion of the synonymy of the group and a list of a few of the herbarium specimens examined.

Of all the characters that have been discussed here there is no single one that can be depended upon absolutely for the separation of species. Those of the spines, especially the centrals, are probably of more value than any others. For the separation of the four species I would offer the following key based upon the spines:

Centrals mostly six; flowers small; petals almost acute. *E. neo-mexicanus.*
Centrals three to five, mostly four; flowers larger; petals broadly obtuse.
  Centrals slender, white or straw-color, 14–40 mm. long, plant depressed at top. *E. coccineus.*
  Centrals stout, terete, usually gray or dark-gray, 15–50 mm. long, plant usually obtuse. *E. polyacanthus.*
  Centrals slender, more or less angled, somewhat curved, usually ashy-gray, 25–80 mm. long, plant rather acute or conical at the top. *E. conoideus.*

ECHINOCEREUS COCCINEUS Engelm. Wisliz. Rep. 9. 1848

Cereus coccineus Engelm. Pl. Fendl. 50. 1849.
Cereus phoeniceus Engelm. Synop. Cact. 284. 1856.
Cereus aggregatus Coult. Cont. Nat. Herb. 3: 396. 1896.
Mammillaria aggregata Engelm. Emory's Rep. 155. 1848,

may be the same species. There is, however, no type specimen existing of this species, and although the original description is accompanied by a drawing of the plant, this drawing is of such a general nature and the description is so brief that it is impossible to tell to just what it refers. The plant illustrated might be either of the species discussed here. In this difficult group of plants it is well to accept only those species of whose identity we are reasonably certain. Consequently it is better to neglect this name for one of which we still have the type specimen.

Specimens examined:

NEW MEXICO: Santa Fé, 1846, *Wislizenus* (type); Santa Fé, *Fendler 272;* Burro Mountains, Grant County, May 20, 1903, *O. B. Metcalfe 82* (the sheets that I have seen, at least); Upper Pecos, Oct. 13, 1853, *J. M. Bigelow;* Anton Chico, 1853, *Bigelow;* also numerous specimens in the cactus garden of the Agricultural College, collected on the mesa west of the Organ Moun-

tains and in the Organ Mountains; several specimens forwarded in 1907 from Santa Fé by Mr. Arthur Boyle. ARIZONA: San Francisco Mountains, Dec. 27, 1853, *Bigelow;* Fort Whipple, May 3, 1865, *Coues & Palmer;* in the vicinity of Flagstaff, May

FIG. 2. Plant of *Echinocereus conoideus.* About one-third natural size (the rule indicates the reduction). The typical form of the species.

31, 1898, *D. T. MacDougal.* COLORADO: Wet Mountain Valley, May 17, 1873, *T. S. Brandegee 541.*

ECHINOCEREUS POLYACANTHUS Engelm. Wisliz. Rep. 20. 1848

Cereus polyacanthus Engelm. Pl. Fendl. 50. 1849.

Specimens examined:

CHIHUAHUA: Cosihuiriachi, 1846, *Wislizenus* (type); on hills near Paso del Norte (now Ciudad Juarez), Apr. 9, 1885, *C. G. Pringle 253:* NEW MEXICO: Las Cruces, May 2, 1895, *E. O. Wooton;* also many specimens in the cactus garden of the Agricultural College, collected upon the mesa west of the Organ Mountains. ARIZONA: On dry ledges in the Santa Rita Mts., Apr. 30, 1881, *C. G. Pringle;* Prescott, May, 1876, *E. Palmer* TEXAS: El Paso, *Thurber 191* and *192; Wright 41*, of 1852 collection (in part); El Paso, 1851, *Wright 228* (in part).

ECHINOCEREUS CONOIDEUS Engelm. Rümpl. Forst. Handb. ed. II, 807. 1886*

Cereus phoeniceus conoideus Engelm. Synop. Cact. 284. 1856.

Cereus conoideus Engelm. Pacif. R. R. Rep. **4**: 36. 1856.

Cereus Roemeri Muhlenpf. Coult. Cont. Nat. Herb. **3**: 395. 1896.

Echinocereus phoeniceus conoideus (Engelm.) Schumann, Gesamtbeschreibung der Kakteen, 283. 1903.

FIG. 3. Plant of *Echinocereus neo-mexicanus*. About one-third natural size.

Cereus Roemeri Muhlenpf. Allg. Gart. Zeit. **16**: 19. 1848 (not Engelm.) may be the same plant but no type of it is preserved and the description is not sufficient to identify it, although it seems to point towards this species.

Specimens examined:

NEW MEXICO: Anton Chico on the Pecos, Sept. 27, 1853, *J. M. Bigelow* (probably the type); Fort Wingate, 1869, *E. Palmer*

*Dr. Engelmann never published this combination but it is credited to him in the work cited.

73; five miles east of Hillsboro, July 12, 1904, *E. O. Wooton 3004*; also many plants growing in the cactus garden of the Agricultural College, brought from the mesa west of the Organ Mountains and from the Doña Ana Mountains. ARIZONA: Fort Whipple, 1865, *Coues & Palmer*.

Echinocereus neo-mexicanus sp. nov.

Plant ovate-cylindrical, cespitose with few stems, obtuse at apex, 18–25 cm. high, about 7 cm. in diameter, glaucous-green: ribs 11–12, obtuse, rather low, 15–18 mm. apart, tuberculate;

FIG. 4. Exterior view of flower of *Echinocereus neo-mexicanus*. Actual size.

FIG. 5. Longitudinal section of flower of *Echinocereus neo-mexicanus* shown in Fig. 4.

areolae 10–15 mm. apart, oval, large: spines rather slender, terete, spreading from the plant; centrals mostly 6, stouter than the radials, rigid, spreading, the lowest one always very light-colored, yellowish, almost white, the others reddish, giving the plant a distinctly reddish and variegated appearance; superior radials 2–5, slender, 4–7 mm. long, unequal, almost white; lateral radials 8, four on each side, spreading, 11–15 mm. long, the lowest longest, of the same color as the superior radials; inferior radials 3, spread-

ing, about as long as the laterals and of the same color: flowers numerous, usually produced all over the plant, a peculiarity in which the plant differs from the other species here discussed; flowers about 50 mm. long, 25–30 mm. in diameter, narrow, not spreading as in the other species; petals firm in texture, almost or quite acute at the apex, upper part of the petals bright-scarlet, lower part greenish-yellow, petals about 6 mm. wide; tube of flower covered with abundant, spreading, rather long, bristle-like spines; stamens about one half as long as the style, anthers rose-colored, filaments white or tinged with rose; stigmas about 7: fruit not seen.

The variegated appearance of the spines, the distribution of the flowers on the plant, the small, contracted flowers, make this species distinguishable. The type is *Standley 383* in the herbarium of the Missouri Botanical Garden, in the Gray Herbarium, and in the National Herbarium, all the specimens being taken from the same plant. A number of the plants are still growing in the College cactus garden; they were brought from the mesa west of the Organ Mountains, Doña Ana Co., New Mexico.

HERBARIUM OF THE NEW MEXICO AGRICULTURAL COLLEGE.

Two Bahamian species of Evolvulus

Homer D. House

The group of species (Arbusculae) typified by *E. Arbuscula* Poir. contains at least four West Indian species. Of these *E. Arbuscula* Poir. * is characterized by erect or ascending leaves, canescent stems, lanceolate, acuminate calyx-lobes and a blue corolla, while *E. purpureo-coeruleus* Hook.,† a little-known species, described from the vicinity of Manchester, Jamaica, is said to possess spreading or reflexed leaves and appressed-pilose stems. The Bahamian material formerly referred to *E. Arbuscula*, consists of two very distinct forms: *E. squamosus* Britton, ‡ characterized by ovate, acute calyx-lobes, reduced or obsolete scale-like leaves, and white corollas; and another which resembles *E. Arbuscula* in the shape of the calyx-lobes, but differs from it in having linear, rather than lanceolate leaves and a white corolla with an almost entire margin.

Evolvulus bahamensis sp. nov.

A tall, stout, erect, shrubby, perennial, intricately branching plant, 40–100 cm. tall; branches rigid and wiry, relatively long and obliquely ascending, sparingly canescent and glabrate below: leaf-blades sessile, linear, strongly ascending or appressed to the stem, 6–15 mm. long, rarely more than 1 mm. wide, the smaller leaves not relatively broader on the ultimate branches: lobes of the calyx lanceolate, slenderly acuminate; the corolla white, the limb entire; stamens nearly as long as the corolla.

Bahama Islands: Inagua, *Nash & Taylor 972, 1111* and *1176* (type), 1904; Watling's Island, *Britton & Millspaugh 6082*, 1907; Conception Island, *Britton & Millspaugh 6022*, 1907; Acklin's Island, *Brace 4262*, 1906; Long Cay, *Brace 4022*, 1906; Eleuthera, *Coker 336*, 1903; Fortune Island, *Eggers 3823*, 1888; Mariguana, *P. Wilson 7475*, 1907; Great Ragged Island, *P. Wilson 7837*, 1907.

* Lam. Encyc. Suppl. 3: 459. 1813.
† Bot. Mag. *pl. 4202.* 1845.
‡ Bull. N. Y. Bot. Gard. 3: 449. 1905.

The South American *E. incanus* Pers. * has been credited to Cuba on the strength of Wright's *no. 3105*. A careful comparison of the excellent specimens of this collection in the New York Botanical Garden with South American material revealed the fact that the Cuban material differs from the true *E. incanus* by its relatively shorter and broader leaf-blades, smaller linear calyx-lobes and a much smaller corolla, as well as by possessing a silky rather than a shaggy pubescence. The Cuban material was accordingly described as *E. Wrightii.* †

Specimens of a closely related species have recently been collected in the Bahama Islands by L. J. K. Brace, which differ from *E. Wrightii* in having smaller leaf-blades, averaging less than half the size of those of *E. Wrightii* and of quite a different shape.

Evolvulus Bracei sp. nov.

Perennial from a lignescent base, branching from near the base; branches spreading, numerous, short, 4–15 cm. long, glabrate toward the base, toward the tips densely silvery-pubescent with rather long, loosely ascending hairs: leaf-blades approximate, sessile, elliptical-ovate, rounded or acute at the base, acute and usually cuspidate at the apex, 3–5 mm. long, 2–3 mm. broad, green above and moderately pubescent with long, loosely appressed silvery hairs, which are 1 mm. long or more, silvery-pubescent beneath with similar but more numerous hairs: flowers solitary on axillary pedicels shorter than the leaves; calyx-lobes lanceolate, acuminate, 2 mm. long, becoming 3 mm. long in fruit, pubescent like the leaves; corolla pale-blue, about 7 mm. broad, the margin slightly 5-lobed; capsules globose, 2–2.5 mm. in diameter, 1-celled, 4-seeded; seeds brown, minutely pitted.

BAHAMA ISLANDS: Andros, Mangrove Cay, *Brace 4893*, 1906; Crooked Island, Landrail Point, *Brace 4575*, Jan. 1906 (type); Mariguana, *P. Wilson 7518*, 1907; North Caicos, *P. Wilson 7719*, 1907.

NEW YORK BOTANICAL GARDEN.

* Pers. Syn. 1: 288. 1805.

† Bull. Torrey Club 33: 316. 1906.

INDEX TO AMERICAN BOTANICAL LITERATURE
(1908)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions their kindness will be appreciated.

This Index is reprinted monthly on cards, and furnished in this form to subscribers, at the rate of one cent for each card. Selections of cards are not permitted; each subscriber must take all cards published during the term of his subscription. Correspondence relating to the card-issue should be addressed to the Treasurer of the Torrey Botanical Club.

Arthur, J. C. Cultures of *Uredineae* in 1907. Jour. Myc. **14**: 7–26. 4 Ja 1908.

Bailey, W. W. Pod and berry. Am. Bot. **13**: 77–79. [Ja 1908.]

Beckmann, P. *Vochysiaceae* novae austro-americanae. Bot. Jahrb. **40**: 279–281. 24 Ja 1908.

Includes *Vochysia Weberbaueri*, *V. Melinonii*, and *Qualea Melinonii*, new species.

Blumer, J. C. Some observations on Arizona fungi. Plant World **11**: 14–17. Ja 1908.

Britton, E. G. A trip to Jamaica in summer. Torreya **8**: 8–12. *f. 1.* 27 Ja 1908.

Campbell, D. H. Studies on some Javanese *Anthocerotaceae* — II. Ann. Bot. **22**: 91–102. *pl. 9, 10 + f. 1, 2.* Ja 1908.

Cannon, W. A. On the electric resistance of solutions of salt plants and solutions of alkali soils. Plant World **11**: 10–14. Ja 1908.

Chase, A. Notes on genera of *Panicaceae* — II. Proc. Biol. Soc. Wash. **21**: 1–10. *f. 1–3* 23 Ja 1908.

Includes new combinations in *Hymenachne* (2), and *Sacciolepis* (5).

Chase, A. Notes on cleistogamy in grasses. Bot. Gaz. **45**: 135, 136. *f. 1.* 15 F 1908.

Clarke, C. B. The *Cyperaceae* of Costa Rica. Contr. U. S. Nat. Mus. **10**: 443–471. 24 Ja 1908.

Includes three new species, one each in *Cyperus*, *Carex*, and *Rynchospora*.

Clute, W. N. Concerning the alliums. Am. Bot. **13**: 73, 74. [Ja 1908.] [Illust.]

Cockerell, T. D. A. A new combination. Muhlenbergia **3**: 143. 16 Ja 1908.

Sabina megalocarpa (Sudw.) Cockerell.

Cockerell, T. D. A. North American *Castalia*. Muhlenbergia **3**: 145. 16 Ja 1908.

Includes 3 new combinations.

Cockerell, T. D. A. *Sisymbrium Vaseyi* (Coulter) Watson. Muhlenbergia **4**: 5. 6 F 1908.

Davis, B. M. Spore formation in *Derbesia*. Ann. .Bot. **22**: 1–20. *pl. 1, 2.* Ja 1908.

De Candolle, C. *Piperaceae* andinae. Bot. Jahrb. **40**: 242–267. 24 Ja 1908.

Includes new species in *Piper* (27), and *Peperomia* (26).

Diels, L. *Alchemillae* species nova andina singularis addita. Bot. Jahrb. **40**: 277. 24 Ja 1908.

Alchemilla diplophylla Diels.

Eastwood, A. Extensions of range. Muhlenbergia **3**: 147. 16 Ja 1908.

New localities for *Lewisia rediviva*, and *L. Leana*.

Eckerson, S. The physiological constants of plants commonly used in American botanical laboratories. Bot. Gaz. **45**: 50–54. 16 Ja 1908.

Evans, A. W. Hepaticae of Puerto Rico — VIII. *Symbiezidium, Marchesinia, Mastigolejeunea, Caudalejeunea*, and *Bryopteris*. Bull. Torrey Club **34**: 533–568. *pl. 31–33.* 11 Ja 1908.

Faull, J. H. *Arceuthobium pusillum* Peck. Ottawa Nat. **21**: 175. 23 Ja 1908.

Fletcher, J. Botanical note. Ottawa Nat. **21**: 182. 23 Ja 1908.

Records occurrence of *Cassia Chamaecrista* near St. Thomas, Ontario.

Gates, R. R. The chromosomes of *Oenothera*. Science II. **27**: 193–195. 31 Ja 1908.

Gow, J. E. Embryogeny of *Arisaema triphyllum*. Bot. Gaz. **45**: 38–44. *f. 1–24.* 16 Ja 1908.

Guillet, C. Kawartha mushrooms. Ottawa Nat. **21**: 176. 23 Ja 1908.

Gürke, M. *Echinocactus coquimbanus* Rümpl. Monats. Kakteenk. **18**: 1, 2, 5. 15 Ja 1908.

Harper, R. M. The pine-barrens of Babylon and Islip, Long Island. Torreya **8**: 1–9. *f. 1, 2.* 27 Ja 1908.

Hasse, H. E. Additions to the lichen flora of southern California. Bryologist **11**: 6, 7. Ja 1908.

Haynes, C. C. Ten lophozias — III. Bryologist **11**: 1–3. *pl. 1.* Ja 1908.

Heller, A. A. The genus *Naiocrene.* Muhlenbergia **3**: 146, 147. 16 Ja 1908.

Hennings, P. Aliquot fungi peruviani novi. Bot. Jahrb. **40**: 225–227. 24 Ja 1908.
Includes new species in *Puccinia* (3), *Calonectria*, *Hypocrella*, and *Dothidella*.

Hieronymus, G. *Compositae* andinae — I. Bot. Jahrb. **40**: 352–394. 24 Ja 1908.
Includes 45 new species.

Holm, T. *Isopyrum biternatum* Torr. et Gr.; an anatomical study. Am. Journ. Sci. IV. **25**: 133–140. *f. 1–3.* F 1908.

Holzinger, J. M. A nomenclatural note. Bryologist **11**: 7. Ja 1908.

Jepson, W. L. Northernmost stations for two common California trees. Muhlenbergia **3**: 144. 16 Ja 1908.

Jepson, W. L. The name of the white sage. Muhlenbergia **3**: 144. 16 Ja 1908.
Publishes *Salvia apiana* Jepson, new name.

Kellerman, W. A. Dr. Rehm's first report on Guatemalan *Ascomycetae.* Jour. Myc. **14**: 3–7: 2 Ja 1908.
Includes 3 new species, one each in *Phyllachora*, *Physalospora*, and *Xylaria*.

Kennedy, P. B. Some notes regarding *Dicoria* with the description of a new species. Muhlenbergia **4**: 1–4. 6 F 1908. [Illust.]
D. Clarkae sp. nov. from Nevada.

Kränzlin, K. *Amaryllidaceae* andinae. Bot. Jahrb. **40**: 227–239. 24 Ja 1908.
Includes new species in *Bomarea* (17), *Alstroemeria*, *Hippeastrum*, and *Stenomesson* (3).

Kränzlin, F. *Iridaceae* andinae. Bot. Jahrb. **40**: 239–242. 24 Ja 1908.
Includes new species in *Sphenostigma*, *Sisyrinchium* (5), and *Symphyostemon*.

Kränzlin, F. *Loganiaceae* austro-americanae. Bot. Jahrb. **40**: 306–312. 24 Ja 1908.
Includes new species in *Spigelia* (3), *Buddleia* (9), and *Desfontainea*.

Krause, K. *Linaceae* andinae. Bot. Jahrb. **40**: 277–279. 24 Ja 1908.
Includes 2 new species in *Linum*.

Krause, K. *Rubiaceae* andinae. Bot. Jahrb. **40**: 312–351. 24 Ja 1908.

Includes 55 new species, and *Acrobotrys*, new genus.

Livingston, B. E. Evaporation and plant habitats. Plant World **11**: 1–9. Ja 1908.

Long, B. *Gymnadeniopsis nivea* in southern New Jersey. Torreya **8**: 16. 27 Ja 1908.

Lorenz, A. Notes on *Radula tenax* Lindb. Bryologist **11**: 8, 9. *pl. 2.* Ja 1908.

Mackenzie, K. K. The pine-barren bellwort. Torreya **8**: 13, 14. 27 Ja 1908.

Macoun, J. M. *Asplenium Ruta-muraria* L. Ottawa Nat. **21**: 183. 23 Ja 1908.

Notes occurrence at Banff, Rocky Mts.

Macoun, J. M. Botanical notes. Ottawa Nat. **21**: 195–197. 12 F 1908.

Magowan, F. N. The toxic effect of certain common salts of the soil on plants. Bot. Gaz. 45: 45–49. 16 Ja 1908. [Illust.]

McElhinney, M. G. Note on experiments relating to the origin of life-forms. Ottawa Nat. **21**: 188. 12 F 1908.

Moore, W. & Behney, M. E. The condition of certain winter buds. Bot. Gaz. **45**: 54. 16 Ja 1908.

Morgan, A. P. North American species of *Agaricaceae* (cont.). Jour. Myc. **14**: 27–32. 2 Ja 1908.

Includes synopsis and descriptions of 17 species of *Hypholoma*.

Mücke, M. Über den Bau und die Entwicklung der Früchte und über die Herkunft von *Acorus Calamus* L. Bot. Zeit. **66**[1]: 1–23 *pl. 1.* 15 Ja 1908.

Murrill, W. A. The collections of fungi. Jour. N. Y. Bot. Gard. 9: 1–9. *f. 1, 2.* Ja 1908.

Muschler, R. *Cruciferae* andinae. Bot. Jahrb. **40**: 267–277. 24 Ja 1908.

Includes *Urbanodoxa* and *Englerocharis*, new genera, and 19 new species.

Nash, G. V. The banyan tree. Jour. N. Y. Bot. Gard. **9**: 10–13. *f. 3.* Ja 1908.

Nelson, A. & Kennedy, P. B. New plants from the Great Basin. Muhlenbergia **3**: 137–143. 16 Ja 1908.

Includes 7 new species, one each in *Boisduvalia*, *Lepidium*, *Chylisma*, *Oreocarya*, *Phlox*, *Plantago* and *Symphoricarpos*.

Nichols, G. E. North American species of *Amblystegiella*. Bryologist **11**: 4, 5. Ja 1908.

Nichols, M. L. The development of the pollen of *Sarracenia*. Bot. Gaz. **45**: 31–37. *pl. 5*. 16 Ja 1908.

Niedenzu, F. *Malpighiacea* nova andina. Bot. Jahrb. **40**: 281. 24 Ja 1908.

Banisteria populifolia sp. nov.

Osterhout, W. J. The antagonistic action of magnesium and potassium. Bot. Gaz. **45**: 117–124. *f. 1–3*. 15 F 1908.

Peck, C. H. New species of fungi. Jour. Myc. **14**: 1–3. 2 Ja 1908.

Includes 6 new species, one each in *Clitocybe*, *Pleurotus*, *Lactarius*, *Entoloma*, *Leptonia* and *Pistillaria*.

Purpus, J. A. *Echinocereus pensilis* (Brandegee) J. A. Purp. Monats. Kakteenk. **18**: 3, 4, 5. 15 Ja 1908. [Illust.]

Ramaley, F. Color variations in some Colorado flowers. Plant World **11**: 17, 18. Ja 1908.

Ricker, P. L. Dates of the signatures of the "Mémoires de l'Académie impériale des sciences de Saint Petersbourg. Series VI. Sciences mathématiques, physiques et naturelles." Proc. Biol. Soc. Wash. **21**: 11–18. 23 Ja 1908.

Rothrock, J. T. Larch, tamarack, hackmatack (*Larix americana* Michx.). Forest Leaves **11**: 104. F 1908. [Illust.]

Schreiner, O. & Reed, H. S. The toxic action of certain organic plant constituents. Bot. Gaz. **45**: 73–102. *f. 1–7*. 15 F 1908.

Schürhoff, P. Ozellen und Lichtkondensoren bei einigen Peperomien. Beih. Bot. Centr. **23**: 14–26. *pl. 2, 3*. 10 Ja 1908.

Setchell, W. A. *Nereocystis* and *Pelagophycus*. Bot. Gaz. **45**: 125–134. 15 F 1908.

Includes *Pelagophycus Porra* (Leman) Setchell comb. nov.

Shull, G. H. Some new cases of Mendelian inheritance. Bot. Gaz. **45**: 103–116. *f. 1–4*. 15 F 1908.

Sprague, T. A. The prickly-fruited species of *Euonymus*. Kew Bull. Misc. Inf. **1908**: 29–36. Ja 1908.

Stevens, A. B. Poison-ivy fruit. Am. Jour. Pharm. **80**: 93. F 1908.

Stone, W. *Rynchospora rariflora* in southern New Jersey. Torreya **8**: 16, 17. 27 Ja 1908.

Trappen, A. von der. Sprossen aus der Zentralachse bei *Echinocactus myriostigma* S.-D. Monats. Kakteenk. **18**: 9, 10. 15 Ja 1908. [Illust.]

Urban, I. Plantae novae andinae imprimis Weberbauerianae — III. Bot. Jahrb. **40**: 225–395. 24 Ja 1908.

Consists of 13 separate papers here indexed under their respective authors: Beckmann, deCandolle, Diels, Hennings, Hieronymus, Kränzlin, Krause, Muschler, Niedenzu, and Wolff.

Weingart, W. *Cereus Baumannii* Lem. Monats. Kakteenk. **18**: 6–8. 15 Ja 1908.

Wieland, G. R. Accelerated cone growth in *Pinus*. Am. Jour. Sci. IV. **25**: 102–104. F 1908. [Illust.]

Wieland, G. R. Historic fossil cycads. Am. Jour. Sci. IV. **25**: 93–101. F 1908. [Illust.]

Williams, R. S. Mosses from tropical America. Bull. Torrey Club **34**: 569–574. 11 Ja 1908.

Includes 5 new species, one each in *Campylopus*, *Dicranodontium*, *Leptodontium*, *Holomitrium*, and *Cyclodictyon*.

Wolff, H. *Umbelliferae* austro-americanae. Bot. Jahrb. **40**: 281–306. 24 Ja 1908.

Includes 34 new species in *Hydrocotyle* (5), *Bowlesia* (6), *Azorella* (3), *Asteriscium* (7), *Eryngium* (8), *Urbanosciadium* gen. nov., *Velaea*, *Arracacia* (2), and *Oreosciadium*.

Yamanouchi, S. Sporogenesis in *Nephrodium*. Bot. Gaz. **45**: 1–30. *pl. 1–4.* 16 Ja 1908.

THE BRYOLOGIST

WITH THE JANUARY, 1908, NUMBER BEGINS ITS

ELEVENTH YEAR AND VOLUME

It is a 16–20 page bi-monthly devoted to the study of the Mosses, Hepatics, and Lichens. It is fully illustrated with new, original, and artistic drawings and half-tones. It is indispensable to the working bryologist, professional as well as amateur. Send for sample copy. Subscription price $1.00 a year.

Address, MRS. ANNIE MORRILL SMITH, 78 Orange Street, Brooklyn, N. Y.

INDEX TO AMERICAN BOTANICAL LITERATURE

This Index, printed each month in the BULLETIN, is reissued on library catalogue cards; these are furnished to subscribers at the rate of one cent for each card.

Subscriptions to the card-issue may be addressed to the Treasurer of the Torrey Botanical Club,

WILLIAM MANSFIELD, COLLEGE OF PHARMACY, 115 W. 68th St., N. Y. City.

Beginning with January, 1903, the Index has also been reprinted on paper, on one side only, and can be furnished in that form at the rate of $3.00 a year.

North American Flora

THIS work is designed to present descriptions of all plants growing independent of cultivation, in North America, here taken to include Greenland, Central America, the Republic of Panama, and the West Indies, except Trinidad, Tobago, and Curaçao and other islands off the north coast of Venezuela, whose flora is essentially South American.

It will be published in parts at irregular intervals by the New York Botanical Garden through the aid of the income of the David Lydig Fund bequeathed by Charles P. Daly.

It is planned to issue parts as rapidly as they can be prepared, the extent of the work making it possible to commence publication at any number of points. The completed work will form a series of volumes with the following sequence:

Volume 1. Mycetozoa, Schizophyta, Diatomaceae.
Volumes 2 to 10. Fungi.
Volumes 11 to 13. Algae.
Volumes 14 and 15. Bryophyta.
Volume 16. Pteridophyta and Gymnospermae.
Volumes 17 to 19. Monocotyledones.
Volumes 20 to 30. Dicotyledones.

The preparation of the work has been referred by the Scientific Directors of the Garden to a committee consisting of Professors L. M. Underwood and N. L. Britton.

Professor George F. Atkinson of Cornell University, Professors Charles R. Barnes and John M. Coulter of the University of Chicago, Mr. Frederick V. Coville of the United States Department of Agriculture, Professor Edward L. Greene of the United States National Museum, Professor Byron D. Halsted of Rutgers College and Professor William Trelease of the Missouri Botanical Garden have consented to act as an advisory committee.

The subscription price is fixed at $1.50 for each part; it is expected that four or five parts will be required for each volume. A limited number of separate parts will be sold at $2.00 each. Address,

THE NEW YORK BOTANICAL GARDEN

BRONX PARK, NEW YORK CITY

Vol. 7, Part 1, Ustilaginales, including Ustilaginaceae and Tilletiaceae, by G. P. Clinton, was issued Oct. 4, 1906. Vol. 7, Part 2, Coleosporiaceae, Uredinaceae and Aecidiaceae (pars), of the Uredinales, by J. C. Arthur was issued March 6, 1907. Vol. 22, Part 1, including Podostemonaceae by George V. Nash, Crassulaceae by N. L. Britton and J. N. Rose, and Penthoraceae and Parnassiaceae by P. A. Rydberg, was issued May 22, 1905. Vol. 22, Part 2, including Saxifragaceae and Hydrangeaceae by J K. Small and P. A. Rydberg, Cunoniaceae, Iteaceae, and Hamamelidaceae by N. L. Britton, Pterostemonaceae by J. K. Small, Altingiaceae by Percy Wilson and Phyllonomaceae by H. H. Rusby, was issued Dec. 18, 1905. Vol. 25, Part 1, including Geraniaceae, by L. F. Hanks and J. K. Small, Oxalidaceae and Linaceae by J. K. Small, and Erythroxylaceae by N. L. Britton, was issued Aug. 24, 1907. Vol. 9, Part 1, Polyporaceae (pars), by W. A. Murrill, was issued Dec. 19, 1907.

PUBLICATIONS BY OFFICERS AND STUDENTS OF THE DEPARTMENT OF BOTANY, COLUMBIA UNIVERSITY

1. MEMOIRS OF THE DEPARTMENT:

Vol. 1. A Monograph of the North American Species of the Genus *Polygonum* (1895). By John Kunkel Small, Fellow in Botany, 1893–1895; Curator of the Herbarium, 1895–1898.

Quarto, 178 pages, 84 plates. Price $6.00.

Vol. 2. A Monograph of the North American Potentilleae (1898). By Per Axel Rydberg, Fellow in Botany, 1896–7.

Quarto, 224 pages, 112 plates. Price $6.00.

2. CONTRIBUTIONS FROM THE DEPARTMENT:

Vol. 1. Nos. 1–25. 1886–1892. Price $5.00.
Vol. 2. Nos. 26–50. 1892–1894. Price $5.00.
Vol. 3. Nos. 51–75. 1894–1895. Price $5.00.
Vol. 4. Nos. 76–100. 1895–1896. Price $5.00.
Vol. 5. Nos. 101–125. 1896–1897. Price $5.00.
Vol. 6. Nos. 126–150. 1897–1898. Price $5.00.
Vol. 7. Nos. 151–175. 1898–1901. Price $5.00.
Vol. 8. Nos. 176–200. 1901–1902. Price $5.00.
Vol. 9. Nos. 201–. 1903–(current).

List of separate numbers available on application.

3. A Text-book of General Lichenology (1896). By Albert Schneider, Fellow in Botany, 1895–1896.

Octavo, 230 pages, 76 plates. Price $4.25 (cloth); $3.80 (paper). Published by Willard N. Clute & Co. Binghamton, N. Y.

The Department invites propositions relative to exchanges of herbarium material for any of the above named publications. Address Dr. Carlton C. Curtis, Columbia University, N. Y. City.

4. An Illustrated Flora of the Northern United States, Canada, and the British Possessions from Newfoundland to the Parallel of the Southern Boundary of Virginia, and from the Atlantic Ocean westward to the 102d Meridian (1896–1898). By Nathaniel Lord Britton, Professor of Botany, 1891–1896; Emeritus Professor 1896–, and Hon. Addison Brown.

Three volumes, royal octavo. Vol. 1, 612 pages; Vol. 2, 642 pages; Vol. 3, 588 pages; 4162 figures in the text, illustrating every species described.

Published by Charles Scribner's Sons, New York. Price, in cloth, $9.00 for the three volumes; with the indexes and keys bound separately, $10.00.

5. Our Native Ferns and their Allies. (Sixth Edition) 1900. By Lucien Marcus Underwood, Professor of Botany, 1896–1907.

Duodecimo, 158 pages, 35 figures. Published by Henry Holt & Co., New York. Price, $1.00.

6. Moulds, Mildews, and Mushrooms. By Lucien Marcus Underwood, Professor of Botany, 1896–1907.

Duodecimo, 236 pages, 10 plates. Published by Henry Holt & Co. Price $1.50.

7. Nature and Development of Plants (1907). By Carlton Clarence Curtis, Assistant in Botany, 1892–1895; Tutor in Botany, 1895–1906; Instructor in Botany, 1906–.

Octavo, 471 pages; 342 illustrations. Published by Henry Holt & Co., New York. Price $2.50.

ESTABLISHED 1851

EIMER & AMEND

205–211 Third Ave.,
Corner 18th Street

NEW YORK

MANUFACTURERS AND IMPORTERS OF

Chemicals and Chemical Apparatus

Our Specialties

MICROSCOPES
and
ACCESSORIES

MICROTOMES

BALANCES
and
WEIGHTS

Sole Agents for

C. A. F.
KAHLBAUM'S
C. P. Chemicals
and Reagents

CARL
SCHLEICHER
& SCHÜLL'S
C. P. Filters

SCHOTT &
GENOSSEN'S
Famous Laboratory Glassware

And for many other renowned European houses in our line.

COMPLETE LINE OF

Bacteriological Apparatus

WE HANDLE

Everything Needed for a Laboratory

Inspection of premises cordially invited.

MEMOIRS OF THE TORREY BOTANICAL CLUB

A series of technical papers on botanical subjects, published at irregular intervals. Price $3.00 a volume. Not offered in exchange.

Vol. 1, No. 1; not furnished separately:

Bailey, Liberty Hyde. Studies of the types of various species of the genus *Carex*. Pages 1–85. 25 My 1889.

Vol. 1, No. 2; not furnished separately:

Martindale, Isaac Comly. Marine algae of the New Jersey coast and adjacen waters of Staten Island. Pages 87–111. 24 Au 1889.

Vol. 1, No. 3; price, 75 cents:

Spruce, Richard. *Hepaticae* Bolivianae, in Andibus Boliviae orientalis, annis 1885–6, a cl. H. H. Rusby lectae. Pages 113–140. 20 Ja 1890.

Vol. 1, No. 4; price, 75 cents:

Sturtevant, Edward Lewis. On seedless fruits. Pages 141–187. 30 My 1890.

Vol. 2, No. 1; not furnished separately:

Halsted, Byron David. Reserve food-materials in buds and surrounding parts. Pages 1–26, *plates 1, 2*. 10 S 1890.

Vol. 2, No. 2; price, 75 cents:

Vail, Anna Murray & Hollick, Charles Arthur. Contributions to the botany of Virginia. Pages 27–56, *plates 3, 4*. 23 D 1890.

Vol. 2, No. 3; not furnished separately:

Holm, Herman Theodor. Contributions to the knowledge of the germination of some North American plants. Pages 57–108, *plates 5–19*. 15 Ap 1891.

Vol. 2, No. 4; price, 75 cents:

Wheelock, William Efner. The genus *Polygala* in North America. Pages 109–152. 30 D 1891.

Vol. 3, No 1; not furnished separately:

Small, John Kunkel & Heller, Amos Arthur. Flora of western North Carolina and contiguous territory. Pages 1–39. 20 F 1892.

Vol 3, No. 2; price, $2.00:

Morong, Thomas. The *Naiadaceae* of North America [with illustrations of all the species]. Pages 1–65, *plates 20–74*. 15 Mr 1893.

Vol. 3, No. 3; not furnished separately:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. [Part 1.] Pages 1–67. 28 Ap 1893.

Vol. 4, No. 1; not furnished separately:

Underwood, Lucien Marcus. Index *Hepaticarum*. Part I, Bibliography. Pages 1–91. 10 Je 1893.

Vol. 4, No. 2; not furnished separately:

Small, John Kunkel & Vail, Anna Murray. Report on the botanical exploration of southwestern Virginia during the season of 1892. Pages 93–201, *plates 75–82*. 18 N 1893–17 Ap 1894.

Vol. 4, No. 3; price, 50 cents:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 2. Pages 203–274. 10 Mr–17 Ap 1895.

Vol. 4, No. 4; price, 50 cents:

Pettit, Anna Stockton. *Arachis hypogaea* L. Pages 275–296, *plates 83–85* 5 Je 1895.

Vol. 4, No. 5; price, 75 cents:

Rydberg, Per Axel. The North American species of *Physalis* and related genera. Pages 297–374. 15 S 1896.

Vol. 5; price, $3.00:

List of *Pteridophyta* and *Spermatophyta* growing without cultivation in northeastern North America. Pages 1–377. 4 D 1893–31 D 1894.

Vol. 6, No. 1; price, $1.25:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 3. Pages 1–130. 17 N 1896.

Vol. 6, No. 2; not furnished separately:

Grout, Abel Joel. A revision of the North American *Isothecieaceae* and *Brachythecia*. Pages 131–210. 30 Jl 1897.

Vol. 6, No. 3; price, 50 cents:

Hazen, Tracy Elliot. The life history of *Sphaerella lacustris* (*Haematococcus pluvialis*). Pages 211–246, *plates 86, 87* (*colored*). 8 Je 1899.

Vol. 6, No. 4; price, 50 cents:

Underwood, Lucien Marcus. A review of the genera of ferns proposed prior to 1832. Pages 247–283. 1 D 1899.

Vol. 6, No. 5; price, 25 cents:

Fink, Bruce. Notes on lichen distribution in the upper Mississippi Valley. Pages 285–307. 1 D 1899.

Vol. 7; price, $3.00:

Howe, Marshall Avery. The *Hepaticae* and *Anthocerotes* of California. Pages 1–208, *plates 88–122*. 5 Au 1899.

Vol. 8, No. 1; not furnished separately:

Lloyd, Francis Ernest. The comparative embryology of the *Rubiaceae*. Part I. Pages 1–26, *plates 1–4*. 26 Au 1899. Part II. Pages 27–112, *plates 5–15*. 15 F 1902.

Vol. 8, No. 2; price, $1.00:

Evans, Alexander William. The *Lejeuneae* of the United States and Canada. Pages 113–183, *plates 16–22*. 15 F 1902.

Vol. 8, No. 3; price, 75 cents:

Britton, Elizabeth Gertrude & Taylor, Alexandrina. The life history of *Vittaria lineata*. Pages 185–211, *plates 23–31*. 30 Au 1902.

Vol. 9; price, $3.00:

Salmon, Ernest Stanley. A monograph of the *Erysiphaceae*. Pages 1–292, *plates 1–9*. 4 O 1900.

Vol. 10; price, $3.00:

Burgess, Edward Sandford. History of Pre-Clusian botany in its relation to *Aster*. Pages i–xii, 1–447. 22 N 1902.

Vol. 11, No. 1; price, $1.75:

Griffiths, David. The North American *Sordariaceae*. Pages 1–134, *plates 1–19*. 30 My 1901.

Vol. 11, No. 2; price, $1.75:

Hazen, Tracy Elliot. The *Ulothricaceae* and *Chaetophoraceae* of the United States. Pages 135–250, *plates 20–42*. 20 O 1902.

Vol. 12, No. 1; price, $1.50:

Northrop, Alice Rich. Flora of New Providence and Andros (Bahama Islands). Pages 1–98, *plates 1–19 + map*. 10 D 1902.

Vol. 12, No. 2; price, $1.00:

Banker, Howard James. A contribution to a revision of the North American *Hydnaceae*. Pages 99–194. 13 Je 1906.

Vol. 12, No. 3; price, 75 cents:

Kupfer, Elsie. Studies in Plant Regeneration. Pages 195–241. 10 Je 1907.

Vol. 13; price, $3.00:

Burgess, Edward Sandford. Species and variations of Biotian Asters, with discussion of variability in *Aster*. Pages i–xv, 1–419, *plates 1–13*. 15 Mr 1906.

Address: **TORREY BOTANICAL CLUB,**
Columbia University, New York City.

VOL. 35 MARCH, 1908 NO. 3

BULLETIN

OF THE

TORREY BOTANICAL CLUB

Editor

MARSHALL AVERY HOWE

Associate Editors

JOHN HENDLEY BARNHART
JEAN BROADHURST
PHILIP DOWELL
ALEXANDER WILLIAM EVANS
TRACY ELLIOT HAZEN
WILLIAM ALPHONSO MURRILL
CHARLES LOUIS POLLARD
HERBERT MAULE RICHARDS

CONTENTS

Studies in the North American Convolvulaceae — IV. The genus Exogonium. (Plates 1 and 2) . . . . . HOMER DOLIVER HOUSE 97
The New England species of Closterium. (Plates 3-5). JOSEPH AUGUSTINE CUSHMAN 109
New ferns described as hybrids in the genus Dryopteris . . PHILIP DOWELL 135
Correlation of flower- and fruit-structure in Carica Papaya . . P. J. WESTER 141
Sorosporium Ellisii Winter, a composite species . . . . . H. S. JACKSON 147
INDEX TO AMERICAN BOTANICAL LITERATURE 151

PUBLISHED FOR THE CLUB

THE NEW ERA PRINTING COMPANY
LANCASTER, PA.

THE TORREY BOTANICAL CLUB

President,

HENRY H. RUSBY, M.D.

Vice-Presidents,

EDWARD S. BURGESS, PH.D. JOHN HENDLEY BARNHART, A.M., M.D.

Recording Secretary,

C. STUART GAGER, PH.D.

Botanical Garden, Bronx Park, New York City.

Treasurer,

WILLIAM MANSFIELD, PHAR.D.

College of Pharmacy,

115 West 68th St., New York City.

MEETINGS

Meetings twice each month from October to May inclusive: the second Tuesday, at 8:00 P.M., at the American Museum of Natural History; the last Wednesday, at 3:30 P.M., in the Museum Building of the New York Botanical Garden.

PUBLICATIONS

All subscriptions and other business communications relating to the publications of the Club should be addressed to the Treasurer, William Mansfield, College of Pharmacy, 115 West 68th St., New York City.

Bulletin. Monthly, established 1870. Price, $3.00 a year; single numbers 30 cents. Of former volumes, only 24–33 can be supplied separately; certain numbers of other volumes are available, but the entire stock of some numbers has been reserved for the completion of sets. Manuscripts intended for publication in the BULLETIN should be addressed to Marshall A. Howe, Editor, New York Botanical Garden, Bronx Park, New York City.

Torreya. Monthly, established 1901. Price, $1.00 a year. Manuscripts intended for publication in TORREYA should be addressed to Jean Broadhurst, Editor, Teachers College, Columbia University, New York City.

Memoirs. Occasional, established 1889. (See last pages of cover.)

Preliminary Catalogue of Anthophyta and Pteridophyta within 100 miles of New York City, 1888. Price, $1.00.

Vol. 35 No 3

BULLETIN

OF THE

TORREY BOTANICAL CLUB

MARCH, 1908

Studies in the North American Convolvulaceae — IV. The genus Exogonium

HOMER DOLIVER HOUSE

(WITH PLATES 1 AND 2)

The genus *Exogonium* is based upon *Ipomoea bracteata* Cav., a Mexican species, and with several other West Indian species forms one of the natural groups of species usually referred to *Ipomoea*. The group is recognized as a genus by Peter and by Hallier, and as a section of *Ipomoea* by Grisebach and by Meissner. *Ipomoea Purga*, which has sometimes been referred to *Exogonium*, appears to be more closely related to a group in *Ipomoea*, of which not all the members possess the salverform corolla and exserted stamens of *I. Purga*, and should more properly be retained in *Ipomoea*. Until very recently the genus was regarded as almost wholly confined to the West Indies. Recent collections in southern Mexico have shown that four species occur in Mexico, one of them apparently identical with *E. argentifolium*, of the West Indies.

EXOGONIUM Choisy, Mém. Soc. Phys. Genèv. 6: 443. 1833.—In DC. Prodr. 9: 346. 1845

Perennial, trailing or twining vines, usually with woody stems. Leaf-blades entire or lobed. Flowers several on axillary peduncles or solitary; bracts large and colored, sometimes inconspicuous or absent. Sepals membranaceous or subherbaceous, equal or unequal, never awned. Corolla scarlet or white; the tube often slender and constricted at the throat or expanding above in a salverform or funnelform limb. Stamens and style exserted or protruding, rarely included. Ovary 2-celled, 4-ovuled. Capsules ovoid, thick-walled, apiculate. Seeds with a long coma of hairs

[The BULLETIN for February, 1908 (35: 49–96), was issued 9 Mr 1908.]

on the dorsal angles, rarely pubescent or glabrous. Stigmas capitately 2-lobed.

Type species: *Ipomoea bracteata* Cav.

The species, about 20 in number, are all confined to North America.

Key to the species

A. Inflorescence with conspicuous bracts.
  Bracts ovate-elliptical to linear-lanceolate.
    Inflorescence long-peduncled.
      Bracts 2–3 cm. long.
        Bracts elliptical-obovate, obtuse; sepals obtuse. — 1. *E. racemosum.*
        Bracts linear-lanceolate; sepals acuminate. — 2. *E. Wrightii.*
      Bracts 1 cm. long, green or tinged with red, subherbaceous. — 3. *E. Rudolphii.*
    Inflorescence sessile or nearly so; bracts linear-lanceolate; foliage velvety-pubescent. — 4. *E. velutifolium.*
  Bracts reniform-ovate, acute, red; inflorescence spicate. — 5. *E. bracteatum.*

B. Inflorescence without conspicuous bracts.
  Leaf-blades silvery-canescent beneath.
    Leaf-blades cordate or subcordate at base.
      Corolla 5 cm. long; leaf-blades silvery beneath, often 3-lobed at the base. — 6. *E. jalapoides.*
      Corolla 3 cm. long or less; leaf-blades sericeous beneath, not lobed. — 7. *E. fuchsioides.*
    Leaf-blades not cordate; corolla about 3 cm. long.
      Corolla glabrous. Cuban. — 8. *E. argentifolium.*
      Corolla pubescent. Mexican. — 9. *E. Conzattii.*
  Leaf-blades neither silvery nor sericeous beneath.
    Corolla salverform, scarlet; leaf-blades entire, lobed or 3–5 parted. — 10. *E. microdactylum.*
    Corolla-limb not salverform.
      Leaf-blades entire or repand.
        Corolla-limb deeply 5-parted, the lobes lanceolate, acute.
          Corolla golden-yellow. Mexican. — 11. *E. luteum.*
          Corolla scarlet. West Indian. — 12. *E. repandum.*
        Corolla with 5 short, triangular, scarcely spreading, acute lobes. — 13. *E. filiforme.*
      Leaf-blades lobed or 3–9-divided.
        Stems creeping; blades very small.
          Corolla scarlet, constricted above. — 14. *E. arenarium.*
          Corolla white, funnelform above. — 15. *E. Eggersii.*
        Stems twining or trailing.
          Corolla white; leaf-blades sinuately lobed. — 16. *E. cubense.*
          Corolla scarlet; blades divided.
            Sepals equal; leaf-segments obtuse.
              Leaf-segments linear; corolla scarlet. — 17. *E. eriospermum.*
              Leaf-segments obovate; corolla greenish; stems minutely pilose. — 18. *E. viridiflorum.*
            Sepals unequal.
              Leaf-segments oblong-lanceolate, acuminate. — 19. *E. leuconeurum.*
              Leaf-segments narrowly lanceolate, obtuse; corolla-tube slightly inflated. — 20. *E. pedatum.*

1. EXOGONIUM RACEMOSUM (Poir.) Choisy, Conv. Rar. 128. 1837. — In DC. Prodr. 9: 346. 1845

Ipomoea racemosa Poir. in Lam. Encyc. Suppl. 4: 633. 1816.
Convolvulus racemosus Spreng. Syst. 1: 600. 1825.
Convolvulus altissimus Spreng. *l. c.* 613.
Ipomoea altissima Bert.; G. Don, Gen. Syst. 4: 273. 1838.

A stout, woody, perennial, branching vine, several m. long, finely pubescent: leaf-blades oblong-ovate, deeply cordate, obtuse, 3–6 cm. long; petioles 1–3 cm. long: peduncles racemosely 2–10-flowered, 6–10 cm. long, each calyx closely subtended by 2–3 elliptical-oblong, obtuse, rose-colored bracts: sepals membranaceous, similar to the bracts: corolla lavender, about 4.5 cm. long, the cylindrical tube slightly constricted above. (PLATE 1, FIGURE *c.*)

TYPE LOCALITY: St. Domingo.

DISTRIBUTION: St. Domingo and Hayti. Reported from Cuba.

SPECIMENS EXAMINED: Hayti, La Brande to Mt. Balance, *Nash & Taylor 1696*, 1905.

2. **Exogonium Wrightii** sp. nov.

Ipomoea racemosa Griseb. Cat. Pl. Cub. 205. 1866. Not *I. racemosa* Poir. 1816.

A stout, woody, perennial, twining vine: stems appressed-pubescent above: leaf-blades ovate, obtuse, deeply cordate, 5–8 cm. long, glabrate above, densely appressed-pubescent beneath, strongly reticulate-veined: peduncles elongated, often terminating branches and leafy, 10–20 cm. long, several-flowered; pedicels filiform, 2–4 cm. long; bracts linear-lanceolate, 1.5–2 cm. long, pubescent: sepals lanceolate, acuminate, appressed-pubescent below, 18–22 mm. long: corolla reddish-purple, salverform, 4 cm. long, the limb as broad: stamens and style exserted 6–10 mm. (PLATE 1, FIGURE *d.*)

CUBA: "N. Sophie [Isle of Pines], climbing to tops of tall trees," *C. Wright 1650*, 1859–1860. (Type in the Gray Herbarium.)

3. **Exogonium Rudolphii** (Roem. & Schult.)

Ipomoea bracteata Rudol.; Ledeb. in Schrad. Neues Jour. Bot. 2: 292. 1807. Not *I. bracteata* Cav. 1799.
Ipomoea Rudolphii Roem. & Schult. Syst. 4: 222. 1819.
Pharbitis bracteata Choisy in DC. Prodr. 9: 344. 1845.
Rivea bracteata Hallier f. Bot. Jahrb. 18: 158. 1894.

Resembling the preceding: stems retrorsely strigose-pubescent: leaf-blades deltoid-ovate, cordate, entire or somewhat 3-lobed, glabrous above, pubescent beneath: peduncles 1- or loosely few-flowered; bracts ovate, obtuse: sepals herbaceous, similar to the bracts but smaller, sometimes acute, 1 cm. long or less: corolla subsalverform, scarlet, 3–4 cm. long; limb 2.5–3 cm. broad: stamens and style exserted. (PLATE I, FIGURE *a*.)

TYPE LOCALITY: St. Domingo.

DISTRIBUTION: St. Domingo and Cuba.

SPECIMENS EXAMINED: Cuba, *C. Wright 3096* (in herb. Gray).

4. **Exogonium velutifolium** sp. nov.

A slender, woody, high-climbing, irregular vine: Stems velvety-pubescent above: leaf-blades oblong-ovate, obtuse, rounded at the base, entire or irregularly crenate-lobed toward the base, 6–30 mm. long, velvety-pubescent; petioles 2–5 mm. long: flowers 2 or 3 together, sessile or nearly so near the ends of the branches; bracts and sepals linear-lanceolate: sepals subequal, acuminate, 7–8 mm. long, tomentose: corolla crimson, glabrous, 3 cm. long or less, slightly constricted at the throat, the slightly spreading limb with 5 rounded lobes, 5–6 mm. long and as broad: stamens and style protruding. (PLATE I, FIGURE *b*.)

MEXICO: Oaxaca, west side of the valley of Cuicatlan, 2000–4000 ft. alt., *E. W. Nelson 1887*, Nov. 9, 1894 (type in herb. Gray; dupl. in Nat. Herb.).

5. EXOGONIUM BRACTEATUM (Cav.) Choisy; G. Don, Gen. Syst. 4: 264. 1838

Ipomoea bracteata Cav. Ic. 5: 51. *pl. 447*. 1799.
Ipomoea spicata H. B. K. Nov. Gen. et Sp. 3: 112. 1819.
Ipomoea cincta Roem. & Schult. Syst. 4: 254. 1819.
Convolvulus obvallatus Spreng. Syst. 1: 595. 1825.
Exogonium spicatum Choisy, Conv. Rar. 128. 1837.—In DC. Prodr. 9: 347. 1845.
Exogonium Olivae Bárcena, Viaje Cav. Cacahuam. 29. 1874.
Convolvulus bractiflorus Sessé & Moc. Pl. Nov. Hisp. 23. 1887.

TYPE LOCALITY: Near Mazatlan, Mexico.

DISTRIBUTION: Lower California and western Mexico to Central America.

SPECIMENS EXAMINED: Sonora, *Palmer 313*, 1890, *10*, 1890; Sinaloa, *W. G. Wright 1258*, 1899, *Palmer 1787*, 1891, *Lamb 450*,

1895; Morelos, *Bilimek 99*, 1866, *Pringle 8012*, 1899; Chihuahua, *Palmer 294, 296*, 1885.

Exogonium bracteatum pubescens (Rob. & Greenm.)

Ipomoea bracteata var. *pubescens* Rob. & Greenm. Am. Jour. Sci. 50: 160. 1895.

MEXICO: Jalisco, Barranca near Guadalajara, *Pringle 4734*, 1894.

6. **Exogonium jalapoides** (Griseb.)

Ipomoea jalapoides Griseb. Cat. Pl. Cub. 202. 1866.

Stems woody below, densely pubescent: leaf-blades oblong-lanceolate, entire, 3–5 cm. long, or 3-lobed at the base, the middle lobe lanceolate, 4-5 cm. long, lateral lobes oblique, 2 cm. long or less, densely appressed-pubescent above: peduncles 1–3-flowered: sepals oblong, obtuse, 7–9 mm. long, densely tomentose without: corolla scarlet, the limb fully 4 cm. broad.

TYPE LOCALITY: Cuba.

DISTRIBUTION: Cuba.

SPECIMENS EXAMINED: *C. Wright 3097* (co-type in herb. Columbia Univ.).

7. **Exogonium fuchsioides** (Griseb.)

Ipomoea fuchsioides Griseb. Cat. Pl. Cub. 205. 1866.

Stems finely appressed-pubescent: leaf-blades narrowly ovate-lanceolate, acuminate, rounded or subcordate at the base, green and appressed-pubescent above, pale and sericeous-pubescent beneath, 2–4 cm. long, sometimes 5–7 cm. long, obtuse, 3–4 cm. wide and obtusely auricled at the base: pedicels and calyx glabrous: sepals unequal, 5–6 mm. long, obtuse, tinged with red: corolla-tube 3 cm. long, 4–5 mm. in diameter; limb crimson, 1.5–2 cm. broad with 5 rounded lobes.

TYPE LOCALITY: Cuba, "Bahia Honda".

DISTRIBUTION: Cuba.

SPECIMENS EXAMINED: *C. Wright 3095* (in herb. Gray). The co-type in the Gray Herbarium is mixed with the entire-leaved form of *E. microdactylum*, which perhaps accounts for the mistaken identification of the latter in most herbaria as "*Ipomoea fuchsioides*." The variety *parvifolia* Griseb. *l. c.* appears to be but a small leaf-form, while the variety *glabra* belongs to the entire-leafed variety of *E. microdactylum*.

8. **Exogonium argentifolium** (A. Rich.)

Ipomoea? argentifolia A. Rich. in Sagra, Hist. Fis. Cuba **11**: 131. 1850.

Ipomoea praecox Wright [in Sauv. Fl. Cub. 107] Anal. Acad. Habana **7**: 46. 1870.

A stout twining vine: stems tomentose above: leaf-blades oblong-lanceolate to elliptical-oblong, acute or rounded at the base, the apex acute or obtuse, 2–10 cm. long, woolly above, becoming glabrate: sepals suborbicular, obtuse, 5–6 mm. long, woolly or tomentose without, equal: corolla salverform, the tube 6–7 mm. in diameter; the limb 3 cm. broad.

TYPE LOCALITY: "Prope Nouvelle Sophie," Isle of Pines.

DISTRIBUTION: Cuba, Isle of Pines, and southern Mexico.

SPECIMENS EXAMINED: Cuba, *C. Wright 449, 3646; Cook*, 1905. Isle of Pines, *Curtiss 489*, 1904, *Rowlee 182*, 1901. Mexico: Oaxaca, *Conzatti & Gonzalez 332*, 1894, *Pringle 5636*, 1894: Puebla, *E. W. Nelson 2009*, 1895, *Pringle 7016*, 1895.

9. **Exogonium Conzattii** (Greenm.)

Ipomoea Conzattii Greenm. Field. Col. Mus. Publ. Bot. **2**: 258. 1907.

Resembling the preceding: leaf-blades not seen: flowers in dense, many-flowered, subsessile clusters; pedicels and peduncles tomentose: sepals slightly unequal, broadly ovate, obtuse, tinged with red: corolla-tube 3 cm. long, the scarlet limb 2 cm. broad, pubescent without: capsules 10–12 mm. in diameter, 2-celled; coma of hairs on the seeds white.

TYPE LOCALITY: Almoloyas, Guerrero, Mexico.

DISTRIBUTION: Southern Mexico.

SPECIMENS EXAMINED: Guerrero, *E. W. Nelson 2095*, 1894 (in herb. Gray and Nat. Herb.). (The type, *Conzatti 1666*, 1906, in herb. Field Mus., not seen.)

10. **Exogonium microdactylum** (Griseb.)

Ipomoea microdactyla Griseb. Cat. Pl. Cub. 204. 1866.

A glabrous twining vine: stems woody below, striated or muricate: leaf-blades 3–5-lobed or subentire, 3–6 cm. long, thick-textured, lobes usually oblanceolate, obtuse, reticulate-veined: peduncles 1–3-flowered: sepals unequal, orbicular-ovate, obtuse, 5–7 mm. long: corolla scarlet, subsalverform, 3–4 cm. long, the limb 3–5 cm. broad and slightly 5–lobed: capsules 10 mm. in diameter, ovoid, apiculate.

TYPE LOCALITY: Cuba.

DISTRIBUTION: Cuba and the Bahamas.

SPECIMENS EXAMINED: Cuba, *C. Wright 3094* (co-type in herb. Columbia Univ.), *Britton, Britton, & Shafer 735*, 1903; Bahamas, Andros, *Northrop 394*, 1890, *Brace 6756*, 1907; Great Exuma, *Britton & Millspaugh 2923*, 1905; Eleuthera, *Britton & Millspaugh 5594*, 1905; Conception Island, *Britton & Millspaugh 6029*, 1907; Long Cay, *Brace 4010, 4173*, 1905; Acklin's Island, *Brace 4280*, 1906; New Providence, *Curtiss 211*, 1903.

Exogonium microdactylum integrifolium var. nov.

Ipomoea repanda Griseb. *l. c.* 204. Not *I. repanda* Jacq. 1760.

Leaf-blades nearly or quite entire, oblong-ovate, subcordate, truncate or sometimes obtuse at the base.

CUBA: *C. Wright 3102* (co-type in herb. Columbia Univ.), *Cook 46*, 1906, *Combs 607*, 1895, *Baker 2171*, 1904. BAHAMAS: New Providence, *Britton & Millspaugh 2105*, 1905, *Britton & Brace 800*, 1904; Crooked Island, *Brace 4627, 4739*, 1906; Rum Cay, *Brace 3982*, 1905; Berry Islands, *Britton & Millspaugh 2336*, 1905; Inagua, *Nash & Taylor 1258, 1310*, 1904; Andros, *Brace 6988*, 1907; Great Bahama, *Brace 3569, 3701*, 1905; Abaco, *Brace 1593*, 1904. Watling's Island, *Wilson 7212*, 1907; North Caicos, *Wilson 7716*, 1907; Mariguana, *Wilson 7521*, 1907. FLORIDA: Pinelands near Cutler, *Small & Carter 788, 816*, 1903. Long Key, *Small & Wilson 1971*, 1903.

11. **Exogonium luteum** sp. nov.

A stout, woody, twining vine, minutely pubescent: leaf-blades triangular-ovate, acuminate, 5–8 cm. long, minutely but densely pubescent above, velvety-pubescent beneath; petioles short: peduncles 5–10 cm. long, tomentose, cymosely many-flowered; pedicels 1.5–3 cm. long: sepals slightly unequal, ovate, obtuse, glabrous or the outer tomentose, 4–6 mm. long: corolla 3–5 cm. long, golden-yellow, the straight tube 5 mm. in diameter, the spreading limb divided to the top of the tube into 5 lanceolate, acute lobes about 15 mm. long, each with a small tuft of white hairs at the tip: stamens and style long-exserted; the sagittate anthers 3.5 mm. long. (PLATE 2, FIGURE *c*.)

MEXICO: Oaxaca, Cuesta de Chiquihuetlan, 3300 ft. alt., *Conzatti & Gonzalez 668*, Sept. 2, 1895 (type in herb. Gray).

12. EXOGONIUM REPANDUM (Jacq.) Choisy, Conv. Rar. 128. 1837. — In DC. Prodr. 9: 347. 1845

Ipomoea repanda Jacq. Pl. Carib. 13. 1760. — Select. Stirp. Amer. 28. *pl. 20.* 1763. — L. Sp. Pl. ed. 2, 1668. 1763.

Convolvulus repandus Desr. in Lam. Encyc. 3: 555. 1789.

TYPE LOCALITY: St. Francis, Martinique.

DISTRIBUTION: In thickets, Porto Rico and the Lesser Antilles.

SPECIMENS EXAMINED: Porto Rico, *Sintenis 5330*, 1886; Martinique, *Duss 1890*, 1880; Guadeloupe, *Duss 2478*, 1892; Grenada, *Broadway*, 1905; Montserrat, *Shafer 401*, 1907.

13. EXOGONIUM FILIFORME (Jacq.) Choisy, Conv. Rar. 127. 1837. — In DC. Prodr. 9: 347. 1845

Ipomoea filiformis Jacq. Pl. Carib. 13. 1760. — Select. Stirp. Amer. 27. *pl. 19.* 1763.

Convolvulus filiformis Desr. in Lam. Encyc. 3: 555. 1789.

TYPE LOCALITY: Martinique.

DISTRIBUTION: In thickets, Porto Rico and the Lesser Antilles.

SPECIMENS EXAMINED: Porto Rico, *Heller*, 1902; Martinique, *Duss 425*, 1879; Guadeloupe, *Madiana 23*, 1872, *Duss 3085*, 1893; St. Thomas, *Eggers 48*, 1887; St. Croix, *Ricksecker 39*, 1895.

14. EXOGONIUM ARENARIUM Choisy, Conv. Rar. 129. *pl. 1.* 1837. — In DC. Prodr. 9: 347. 1845

Ipomoea arenaria Steud. Nom. ed. 2. 815. 1841. Not *I. arenaria* Roem. & Schult. 1819.

Ipomoea Steudeli Millsp. Field. Col. Mus. Publ. Bot. 2: 86. 1901.

TYPE LOCALITY: Caribbean Islands.

DISTRIBUTION: Littoral, Porto Rico and the Lesser Antilles.

SPECIMENS EXAMINED: Porto Rico: *Underwood & Griggs 544, 547*, 1901, *Sintenis 3457*, 1888, *Heller 6170*, 1902; Culebra, *Britton & Wheeler 30*, 1906. (PLATE 2, FIGURE *d.*)

15. **Exogonium Eggersii** sp. nov.

A perennial, slender, trailing vine, exactly simulating the preceding: leaf-blades 3–12 mm. long, nearly as broad, obcordate or notched at the apex, the base truncate or hastately lobed: peduncles 6–8 mm. long, 1-flowered: sepals equal, orbicular-ovate,

glabrous, 5–6 mm. long, rounded: corolla white, funnelform, expanding from the base upward, 3.5–4 cm. long, the limb 3–3.5 cm. broad with 5 slightly rounded lobes: capsules ovoid, exceeding the calyx; seeds lanate on the dorsal angles. (PLATE 2, FIGURE *a*.)

ST. THOMAS: *Eggers*, Feb. 1887 (type in herb. N. Y. Bot. Garden), January 14 and March 24, 1876; *266*, 1880 (in herb. Gray).

16. **Exogonium cubense** sp. nov.

A slender, perennial, twining vine, several m. high: stems woody below: leaf-blades ovate, or ovate-lanceolate, 3–8 cm. long, obtuse or subcordate at the base, entire or sinuately 3–5-lobed, middle lobe largest, lateral ones oblique and half as long; petioles shorter than the blades: peduncles 2–5 cm. long, 2–5-flowered; pedicels 10–15 mm. long: sepals unequal, the inner larger, ovate, obtuse, 8–10 mm. long and nearly as broad, the outer 5–6 mm. long: corolla white, about 5 cm. long, the tube 2–2.5 cm. long, thicker within the calyx than above, where it begins to expand into a funnelform or subsalverform limb 4–5 cm. broad and 5-lobed, the externally green plaits of the corolla ending in minute cusps at the margin. (PLATE 2, FIGURE *b*.)

CUBA: Gorge of the Yumuri, Matanzas, *Britton & Shafer 495*, March 20, 1903 (type in herb. N. Y. Bot. Garden).

This might be the *Ipomoea alterniflora* Griseb. as to all parts except the corolla, which is described as being purple, and an unnumbered specimen of Wright's so labeled in the Gray Herbarium is identical with *E. cubense*. All material of Wright's, other than this, labeled *I. alterniflora*, is *Ipomoea obtusata* Griseb. and it is evident that either the corolla was wrongly described in *I. alterniflora*, or what is more likely, considering the mixture of species under some of Wright's numbers, that the description of *I. alterniflora* represents two species, viz. *E. cubense* in part and *Ipomoea obtusata* as to the flowers.

17. EXOGONIUM ERIOSPERMUM (Desr.) Choisy, Conv. Rar. 130. 1837.—In DC. Prodr. **9**: 347. 1845

Convolvulus eriospermus Desr. in Lam. Encyc. **3**: 567. 1789.

Ipomoea eriosperma Raf. Fl. Tellur. **4**: 74. 1838.—Urb. Symb. Ant. **3**: 350. 1902. Not *I. eriosperma* Beauv. 1807.

Ipomoea Desrousseauxii Steud. Nom. ed. 2. 816. 1841.

TYPE LOCALITY: St. Domingo.

DISTRIBUTION: St. Domingo.

SPECIMENS EXAMINED: *Wright, Parry, & Brummel 378*, 1871 (in Nat. Herb.).

18. **Exogonium viridiflorum** (Urb.)

Ipomoea viridiflora Urb. Symb. Ant. 3: 348. 1902.

Stems dark-red, striate, minutely pilose above: leaf-blades pedately divided, middle lobe 3–4 cm. long, 1.5–2.5 cm. broad; petioles 2–3 mm. long: peduncles 1–2 cm. long, 1–few-flowered: sepals obovate-orbicular, 6 mm. long, the inner ones emarginate.

TYPE LOCALITY: Hayti.

DISTRIBUTION: Hayti.

19. **Exogonium leuconeurum** (Urb.)

Ipomoea leuconeura Urb. Symb. Ant. 3: 350. 1902.

Prostrate or trailing: stems woody below, striate: leaf-blades digitately 7- (rarely 5- or 6-) divided, segments 5–30 mm. long, attenuate below into petiolules 3 mm. long: peduncles 2-7 mm. long, 1–10-flowered; pedicels 7–12 mm. long: sepals green or tinged with red, unequal, outer 3.5 mm. long, inner narrowly ovate or obovate, 5 mm. long, rounded or emarginate: corolla scarlet, 35–45 mm. long, slightly inflated in the middle, the limb about 25 mm. broad: capsules oblong, 15 mm. high; seeds with a yellowish white coma of long reflexed hairs.

TYPE LOCALITY: Hayti.

DISTRIBUTION: Hayti. No specimens seen.

20. EXOGONIUM PEDATUM Choisy, Conv. Rar. 130. 1837.—In DC. Prodr. 9: 347. 1845

Stems woody below, terete: leaf-blades pedate, lateral lobes 2-parted; segments petiolulate, narrowly lanceolate, obtuse, 1.5–3 cm. long, 4–7 mm. wide or less: peduncles 2–5 cm. long, 2–6-flowered: outer sepals slightly shorter than the inner, which are about 4 mm. long, oval: corolla red, 3.5–4.5 cm. long.

TYPE LOCALITY: St. Domingo.

DISTRIBUTION: Hayti and St. Domingo.

SPECIES INQUIRENDAE

IPOMOEA RUBROCINCTA Urb. *l. c.* 347. Doubtfully distinct from *E. pedatum*, from the description, although no specimens have been seen.

IPOMOEA NEMATOLOBA Urb. *l. c.* 349. Stems plicate-striate: leaf-blades digitately divided into 5–7, obtuse, filiform segments, 35 mm. long by 0.5 mm. wide; petioles 3–9 mm. long: peduncles 1–3 mm. long: outer sepals oval, 3 mm. long, inner ones 3.5 mm. long, rounded at the apex: corolla white, tinged with green, the oval, subemarginate lobes of the limb 9–10 mm. long. Hayti.

NEW YORK BOTANICAL GARDEN.

The New England species of Closterium

Joseph Augustine Cushman

With the exception of the very large genera *Cosmarium* and *Staurastrum*, the genus *Closterium* is usually the most noticeable in number of species and individuals of any genus of desmids. Oftentimes pure collections may be obtained of certain species in ditches or small pools. The genus is an interesting one in showing the many changes that may take place in a simple form without a complication of lobes and about a single axis.

In its generalized form *Closterium* consists of an arcuate cell tapering from the middle toward the ends and generally circular in cross-section. Upon this simple plan of structure all the various differences in shape, size, and ornamentation take place. All gradations exist between species in which the axis is a straight line to those in which it forms a semicircle. The cell-wall may be colorless or in older specimens various shades of yellowish or reddish-brown. The surface may be smooth or have delicate striations, costae, or even longitudinal markings made up of a series of granules arranged in a longitudinal manner. The apices of the cell form one of the constant features in the species. In the genus they range from squarely truncate to the finest of acute points or even may be larger than the adjacent portions of the cell. In a few of the species the ends of the cell are drawn out into long colorless setaceous beaks.

There are two distinct groups of *Closterium*, according to the manner of division. In one, the cell divides in the middle and the new halves are of the usual size, the new cells being of practically the same length as the first. In another group, division may take place and then be followed by an elongation of the old cell by the insertion of a median section between the original semi-cells. The limits of this are shown by distinct transverse lines across the cell, each suture really representing a cell division.

The semi-cells each contain a single chloroplast, with longitudinal ridges in most cases; at the distal end of the chloroplast is a

vacuole containing one or more crystals of calcium sulphate in continuous motion. Since the desmids were first known, these granules have been a point of interest.

The zygospores of *Closterium* are usually formed between the parent cells and are free. In certain cases the zygospores are paired but usually single and globose. As a rule the zygospores are smooth but in a few species there are spines. In a few species cruciform or quadrate zygospores are formed and the cells remain attached for some time.

Enough synonymy is given under each species to refer to published figures in accessible works and to straighten out many of the New England records already published. The figures given are camera-lucida drawings from specimens. The figures given by Wolle were in many cases rather too conventionalized to represent clearly the form he had under observation. In all, about fifty species of this genus are now known from New England. Those not previously recorded are indicated by an asterisk. The measurements and short description are based entirely upon observed specimens from New England.

As given here, length means the length of a straight line drawn between the apices — not the length of the axis of the cell. Breadth means the diameter across the middle of the cell; where the cross-section of the cell is elliptical, as it is in some of the straight forms, the greatest diameter is given. Records for which I have seen specimens are followed by an exclamation point. In other cases the author's name is given in parentheses.

It will be noted that many of the species are recorded only from southeastern Massachusetts and Rhode Island. Collections from this region were especially rich in *Closterium*, both in number of species and individuals.

1. CLOSTERIUM CYNTHIA DeNot.

Closterium Cynthia DeNot. Elem. Stud. Desm. Ital. 65, *pl. 7. f. 71.* 1867. — Johnson, Bull. Torrey Club **22**: 291. *pl. 239. f. 3.* 1895. — W. & G. S. West, Brit. Desm. **1**: 113. *pl. 11. f. 1–3.* 1904.

Cells small, about 8–10 times as long as wide, strongly curved, apices obtusely rounded; cell-wall yellow-brown with about 13–16 striae visible across the cell.

Length 140–170 μ; breadth 15.5–19 μ; apices 3.5–4 μ; diameter of zygospore 40–46 μ. (PLATE 3, FIGURES 1, 2.)

NEW HAMPSHIRE: North Woodstock!

MASSACHUSETTS: Reading, with zygospores! Lake Watuppa, Fall River!

*2. CLOSTERIUM MALMEI Borge

Closterium Malmei Borge, Arkiv för Botanik 1: 79. *pl. 1. f. 21.* 1903.

Cells of medium size, about six times as long as wide, strongly curved, outer margin an arc of 140°, inner margin not tumid but evenly curved throughout, gradually narrowed to the apices, which are slightly dilated, then suddenly attenuated; cell-wall reddish-brown in color, with about 10–12 costae visible across the cell.

Length 250–405 μ; breadth 50–63 μ; apex 11–15.5 μ. (PLATE 3, FIGURES 4, 5.)

MASSACHUSETTS: East Bridgewater! Chilmark (H. C., *no. 663*)!

Our specimens seem to be identical with those of Borge, described from Paraguay as *C. Malmei.*

*3. CLOSTERIUM ARCHERIANUM Cleve

Closterium Archerianum Cleve, in Lund. Nova Acta Reg. Soc. Sci. Upsal. III. 8: *77. pl. 5. f. 13.* 1871.—W. & G. S. West, Brit. Desm. 1: 115. *pl. 11. f. 8–10.* 1904.

Cells of medium size, about ten times as long as wide, strongly curved, narrowing regularly to the apices; cell-wall brown with 8–10 striae visible across the cell.

Length 185–210 μ; breadth 19–22 μ. (PLATE 3, FIGURE 3.)

MASSACHUSETTS: Reading!

4. CLOSTERIUM DIDYMOTOCUM Corda

Closterium didymotocum Corda, Alm. de Carlsbad, 185, 190, 192, 209. *pl. 5. f. 64, 65.* 1835.—Wolle, Desm. U. S. 39. *pl. 8. f. 12, 13.* 1884.—Johnson, Bull. Torrey Club 21: 286. 1894.—W. & G. S. West, Brit. Desm. 1: 116. *pl. 12. f. 1–5.* 1904.

Closterium Ensis Cushman, Rhodora 5: 255. 1903.

Cells large, 9–12 times as long as wide, slightly curved, apices broad, truncated, angles rounded, often slightly recurved; cell-wall yellow-brown, ends with a darker annular thickening, smooth or often delicately striate.

Length 310–560 μ; breadth 25–56 μ; apices 12.5–18.6 μ. (PLATE 3, FIGURE 16; PLATE 5, FIGURE 6.)

MAINE: Orono (*W. West*); Kittery! Mud Pond, Township 6, Range 12!

NEW HAMPSHIRE: Intervale! Mt. Moosilauke!

MASSACHUSETTS: Reading! East Bridgewater! Lake Watuppa, Fall River! Milford Pond, Swansea!

RHODE ISLAND: Nyatt!

This species is recorded among the rare desmids of the United States by L. N. Johnson, but it has been found frequently in New England, as the above records show. It has usually been common in the collections in which it has occurred. The delicate striae are very noticeable on specimens from certain localities. Those from Lake Watuppa and Nyatt had them in the majority of cases.

4*a*. **Closterium didymotocum Johnsonii** (W. & G. S. West) comb. nov.

Closterium Johnsonii W. & G. S. West, Jour. Linn. Soc. **33**: 284. *pl. 16. f. 1, 2.* 1898.

Cells more slender, about 17 times as long as wide, central portion nearly straight with subparallel sides, ends gradually attenuated and slightly curved; apices broad, truncated; ends with the darker annular thickening, yellow-brown, smooth.

Length 357 μ; breadth 21 μ; apices 12 μ.

NEW HAMPSHIRE: Plymouth! (Type, H. J., *no. 655.*)

The type of *C. Johnsonii* now in the collection at Harvard University has been examined carefully. I am not satisfied that the apparent sigmoid character of one semi-cell is more than accidental. The other semi-cell does not show it. The ends have the annular thickenings and the broad truncate apices of *C. didymotocum.* It is more attenuated than the typical and slightly smaller.

5. CLOSTERIUM MACILENTUM Bréb.

Closterium macilentum Bréb. Mém. Soc. Sci. Nat. Cherbourg **4**: 53. *pl. 2. f. 36.* 1856. — Wolle, Desm. U. S. 38. *pl. 6. f. 6.* 1884. — W. & G. S. West, Brit. Desm. **1**: 118. *pl. 12. f. 8–10.* 1904.

Cells of medium size, 25–35 times as long as wide, nearly straight, slightly curved toward the ends, apices obtusely rounded; cell-wall smooth, colorless.

Length 360–527 μ; breadth 11–16 μ; apices 4.5–6 μ. (PLATE 3, FIGURE 17.)

NEW HAMPSHIRE: Intervale!

MASSACHUSETTS: Carver's Pond, Bridgewater! Lake Watuppa, Fall River! Eastham!

6. CLOSTERIUM ANGUSTATUM Kütz.

Closterium angustatum Kütz. Phyc. Germ. 132. 1845. — Wolle, Desm. U. S. 40. *pl. 6. f. 21.* 1884. — W. & G. S. West, Brit. Desm. **1**: 119. *pl. 12. f. 11–13.* 1904.

Cells of medium size, moderately curved, 10–18 times as long as wide, apices truncately rounded; cell-wall reddish- or yellowish-brown, ends darker, usually 4 costae visible across the cell.

Length 240 μ; breadth 20 μ; apices 15 μ.

MAINE: Orono (*W. West*).

MASSACHUSETTS: Berkshire Mts. (*Wolle*); Tewksbury (*Lagerheim*).

RHODE ISLAND: Wainskut Pond, North Providence (*Bailey*).

Although this species has several times been reported from New England, all the New England specimens seen in the material I have examined belong to the following variety, and some of the previously recorded specimens are placed there.

7. CLOSTERIUM ANGUSTATUM CLAVATUM Hastings

Closterium angustatum clavatum Hastings, Am. Month. Micr. Jour. **13**: 155. *pl. 1. f. 7.* 1892. — Johnson, Bull. Torrey Club **22**: 291. *pl. 239. f. 6.* 1895.

Cells larger than the typical, ends tumid and clavate; cell-wall with 3 or 4 costae visible, often spirally twisted at the apices.

Length 355–650 μ; breadth 21–34 μ; apices 15–21 μ. (PLATE 3, FIGURE 12.)

MAINE: Mud Pond, Township 6, Range 12!

NEW HAMPSHIRE: Hanover (*Edwards*); Saco Lake (*Wood*); Rochester (*Hastings*); North Woodstock!

MASSACHUSETTS: East Bridgewater! Lake Watuppa, Fall River!

CONNECTICUT: Bridgeport, scarce (*Johnson*).

Wolle describes var. *reticulatum* and var. *decussatum*, both of which evidently apply to the same thing. Just what Wolle had, it

is difficult to determine. His specimens were from Mt. Everett, Massachusetts. Collections which I made there in May, 1907, failed to show anything which might suggest these forms.

8. CLOSTERIUM COSTATUM Corda

Closterium costatum Corda, Alm. de Carlsbad, 185, etc. *pl. 5. f. 61–63.* 1834. — Wolle, Desm. U. S. 42. *pl. 6. f. 19.* 1884. — W. & G. S. West, Brit. Desm. 1: 120. *pl. 13. f. 1–3.* 1904.

Cells of medium size, 7–9 times as long as wide, moderately curved, apices rounded; cell-wall dark yellowish-brown, with 6–8 costae visible across the cell.

Length 215–410 μ; breadth 29–44 μ. (PLATE 3, FIGURE 13.)

MAINE: Orono (*W. West*).

NEW HAMPSHIRE: Pudding Pond, North Conway! Intervale!

MASSACHUSETTS: Amherst (*W. West*); Tewksbury (*Lagerheim*); Lake Quinsigamond, Worcester (*Stone*); Reading! West Bridgewater! Gay Head! Almanac Pond, Nantucket!

8a. CLOSTERIUM COSTATUM WESTII Cushman

Closterium costatum Corda, *forma*, W. & G. S. West, Trans. Linn. Soc. Bot. II. 5: 237. *pl. 13. f. 23, 24.* 1896.

Closterium costatum Westii Cushman, Rhodora 7: 114. 1905.

Cells only slightly curved, smaller than the typical, tumid in the middle, apices truncate; cell-membrane punctate between the costae.

Length 230–300 μ; breadth 25–32 μ; apices 10–12 μ. (PLATE 3, FIGURE 14.)

NEW HAMPSHIRE: North Woodstock! Pudding Pond, North Conway!

MASSACHUSETTS: Gay Head, Marthas Vineyard!

9. CLOSTERIUM REGULARE Bréb.

Closterium regulare Bréb. Mém. Soc. Sci. Nat. Cherbourg 4: 148. *pl. 2. f. 35.* 1856. — W. & G. S. West, Brit. Desm. 1: 122. *pl. 13. f. 4–6.* 1904.

Cells of medium size, 7–9 times as long as wide, moderately curved, apices truncately or angularly rounded; cell-wall light yellowish-brown, with 10–12 costae visible across the cell.

Length 230–310 μ; breadth 25–37 μ; apices 6.5–9.5 μ. (PLATE 3, FIGURE 15.)

NEW HAMPSHIRE: Intervale!
MASSACHUSETTS: Lake Watuppa, Fall River!
RHODE ISLAND: Nyatt!

10. CLOSTERIUM STRIOLATUM Ehrenb.

Closterium striolatum Ehrenb. Phys. Abh. Akad. Wiss. Berlin 1830: 68. 1832. — Wolle, F.-W. Alg. U. S. 24. *pl. 55. f. 5–8*; Desm. U. S. 44. *pl. 6. f. 5–8. pl. 7. f. 8, 20.* 1892. — W. & G. S. West, Brit. Desm. **1**: 122. *pl. 13. f. 7–16.* 1904.

Cells of medium size, moderately curved, 8–12 times as long as wide, apices broadly truncate, angles rounded; cell-wall yellowish-brown, with 12–20 striae visible across the cell.

Length 220–375 μ; breadth 19–44 μ; apices 9–12.5 μ. (PLATE 3, FIGURE 10.)

MAINE: Basin Mills and Orono (*Harvey*).

NEW HAMPSHIRE: Saco Lake (*Wood*); Meredith and Plymouth (*Johnson*).

MASSACHUSETTS: Amherst (*W. West*); Lake Quinsigamond, Worcester (*Stone*); near Salem (*Bailey*); Bridgewater! Pondville! South Framingham! Reading! Lake Watuppa, Fall River! Eastham (zygospores)!

10*a*. CLOSTERIUM STRIOLATUM ERECTUM Klebs

Closterium striolatum erectum Klebs, Schrift. Physik.-oekonom. Gesells. Königsberg **22**: 14. *pl. 2. f. 3, 4 b, 4 c, 10.* 1879.

Resembling the typical, but with the median portion straight and the ends abruptly curved.

Length 360 μ; breadth 34 μ. (PLATE 3, FIGURE 11.)

NEW HAMPSHIRE: North Woodstock!

Although this variety may be connected with the typical form, it was very common at this one locality and the typical form was absent.

11. CLOSTERIUM INTERMEDIUM Ralfs

Closterium intermedium Ralfs, Brit. Desm. 171. *pl. 29. f. 2h, 3.* 1848. — W. & G. S. West, Brit. Desm. **1**: 125. *pl. 14. f. 1–5.* 1904.

C. striolatum Ehrenb., var. *intermedium* Cushman, Rhodora **5**: 255. 1903; **7**: 115. 1905.

C. striolatum Ehrenb., var. *elongatum* Cushman, *l. c.* 115. 1905.
C. subdirectum West, Jour. Roy. Micr. Soc. 1889: 17. *pl. 3. f. 16.* 1889.

Cells of medium size, 11–13 times as long as wide, moderately curved, apices truncate with rounded angles; cell-wall yellowish-brown, with 7–10 striae visible across the cell.

Length 220–370 μ; breadth 19–28 μ; apices 8–11 μ.

MAINE: Kittery!

NEW HAMPSHIRE: Intervale!

MASSACHUSETTS: Amherst (*W. West*); South Framingham! Plainville! Pondville! East Bridgewater! North Watuppa Lake, Fall River! Westport! Swansea!

RHODE ISLAND: Nyatt!

*12. CLOSTERIUM ULNA Focke

Closterium Ulna Focke, Physiologische Studien 59. *pl. 3. f. 30.* 1847.—W. & G. S. West, Brit. Desm. 1: 127. *pl. 14. f. 7–9.* 1904.

Cells of medium size, about 30 times as long as wide, apices truncate; cell-wall slightly yellow, with 15–20 fine striae visible across the cell.

Length 370 μ; breadth 11.5 μ; apices 7.5 μ. (PLATE 3, FIGURE 9.)

MASSACHUSETTS: Randolph!

The specimens from this locality were very elongate, otherwise they were typical.

13. CLOSTERIUM JUNCIDUM Ralfs

Closterium juncidum Ralfs, Brit. Desm. 172. *pl. 29. f. 6.* 1848.—Wolle, Desm. U. S. 38. *pl. 6. f. 2, 3.* 1884.—W. & G. S. West, Brit. Desm. 1: 128. *pl. 14. f. 10–14.* 1904.

Cells long and slender, 30–45 times as long as wide, median portion straight and of uniform width, apices slightly curved, obtusely rounded; cell-wall yellowish-brown, with 5–7 striae visible across the cell.

Length 210–375 μ; breadth 6–8.5 μ; apices 3.5 μ. (PLATE 3, FIGURE 18.)

MAINE: Orono (*Harvey*); Kittery!

NEW HAMPSHIRE: Saco Lake (*Wood*); Pudding Pond, North Conway!

MASSACHUSETTS: Lake Quinsigamond, Worcester (*Stone*); South Framingham! Lake Watuppa, Fall River!

* 13*a*. CLOSTERIUM JUNCIDUM ELONGATUM Roy & Biss.

Closterium juncidum elongatum Roy & Biss. Ann. Scot. Nat. Hist. 245. 1894. — W. & G. S. West, Brit. Desm. 1: 130. 1904.

Cells broader than in the typical form, 26–36 times as long as wide.

Length 310–381 μ; breadth 11.5–12 μ; apices 7 μ.

MASSACHUSETTS: Tewksbury (*Lagerheim*); Lake Watuppa, Fall River!

* 13*b*. CLOSTERIUM JUNCIDUM BREVIUS Roy

Closterium juncidum var. β Ralfs, Brit. Desm. 172. *pl. 29. f. 7.* 1848.

Closterium juncidum β *brevior* Roy, Jour. Bot. 28: 336. 1890. — W. & G. S. West, Brit. Desm. 1: 129. *pl. 14. f. 15, 16.* 1904.

Cells relatively broader than in the typical, 12–15 times as long as wide.

Length 165–210 μ; breadth 12.5–13.5 μ. (PLATE 3, FIGURE 19.)

MASSACHUSETTS: Lake Watuppa, Fall River!

14. CLOSTERIUM DIANAE Ehrenb.

Closterium Dianae Ehrenb. Infusionsth. 92. *pl. 5. f. xvii. 1–6.* 1838. — Wolle, Desm. U. S. 45. *pl. 7. f. 9. pl. 8. f. 4.* 1884. — W. & G. S. West, Brit. Desm. 1: 130. *pl. 15. f. 1–6.* 1904.

Closterium acuminatum Wolle, Desm. U. S. 44. *pl. 7. f. 18, 19.* 1884.

Cells of medium size, strongly curved, attenuated to the obtusely rounded apices, the dorsal margin of each being obliquely truncated and thickened; cell-wall yellowish-brown, smooth; zygospores spherical.

Length 325–360 μ; breadth 25–31 μ; diameter of zygospores 36–40 μ. (PLATE 4, FIGURE 12.)

MAINE: Orono (*Harvey, W. West*); Kittery, frequent!

NEW HAMPSHIRE: Pudding Pond, North Conway!

MASSACHUSETTS: Amherst (*W. West*); Lake Quinsigamond,

Worcester (*Stone*); Mt. Everett (*Wolle*); Bridgewater! Reading, (zygospores)!

RHODE ISLAND: Wainskut Pond, North Providence (*Bailey*).

The obliquely truncated and thickened dorsal margin of the apices is very characteristic.

* 14*a*. CLOSTERIUM DIANAE ARCUATUM (Bréb.) Rabenh.

Closterium arcuatum Bréb. in Ralfs, Brit. Desm. 219. 1848.

Closterium Dianae arcuatum Rabenh. Flor. Europ. Alg. **3**: 133. 1868. — Wolle, Desm. U. S. *pl. 7. f. 8.* 1884. — W. & G. S. West, Brit. Desm. **1**: 131. *pl. 15. f. 21, 22.* 1904.

Slightly smaller and more strongly curved than in the typical form, about 10 times as long as wide.

Length 190 μ; breadth 19 μ.

MASSACHUSETTS: Cedar Pond, North Falmouth!

* 15. CLOSTERIUM PSEUDODIANAE Roy

Closterium Pseudodianae Roy, Scottish Naturalist **10**: 201. 1890. — W. & G. S. West, Brit. Desm. **1**: 132. *pl. 15. f. 7, 8.* 1904.

Cells of medium size, moderately curved, 15–20 times as long as wide, apices narrow and obtuse; cell-wall colorless or light yellowish-brown, smooth.

Length 155–254 μ; breadth 11.5–12.5 μ; apices 2.5–3 μ. (PLATE 5, FIGURE 1.)

MASSACHUSETTS: North Lake Watuppa, Fall River! Cedar Pond, North Falmouth!

RHODE ISLAND: Nyatt!

This species is narrower and less curved than *C. Dianae* but is not nearly so common. It has not previously been reported from the United States.

16. CLOSTERIUM PARVULUM Näg.

Closterium parvulum Näg. Gatt. einz. Alg. 106. *pl. 6 C. f. 2* (in part). 1849. — Wolle, Desm. U. S. 45. *pl. 7. f. 7. pl. 8. f. 16.* 1884. — W. & G. S. West, Brit. Desm. **1**: 133. *pl. 15. f. 9–12.* 1904.

Closterium calosporum Cushman, Rhodora **7**: 115. 1905.

Cells small, strongly curved, 10–12 times as long as wide, apices acutely rounded; cell-wall colorless, smooth.

Length 108–170 μ; breadth 10–15 μ; apices 1.5–2.3 μ. (PLATE 3, FIGURES 6, 7.)

MAINE: Orono (*Harvey*); Mud Pond, Township 6, Range 12!

NEW HAMPSHIRE: Pudding Pond, North Conway!

MASSACHUSETTS: Amherst (*W. West*); Lake Quinsigamond, Worcester (*Stone*); South Framingham! Medford!

In the absence of zygospores, the *C. calosporum* reported from North Conway, N. H. is included here.

17. CLOSTERIUM JENNERI Ralfs

Closterium Jenneri Ralfs, Brit. Desm. 167. *pl. 28. f. 6.* 1848. — Wolle, Desm. U. S. 44. *pl. 7. f. 5.* 1884. — W. & G. S. West, Brit. Desm. 1: 134. *pl. 15. f. 23–25.* 1904.

Cells small, strongly curved, especially toward the ends, the middle portion nearly straight, apices obtusely rounded; cell-wall colorless, smooth.

Length 40–75 μ; breadth 6–10 μ. (PLATE 5, FIGURES 3, 4.)

MAINE: Mud Pond, Township 6, Range 12!

MASSACHUSETTS: Amherst (*W. West*); Lake Quinsigamond, Worcester (*Stone*); Misery Island, off Beverly, rare! Lake Watuppa, Fall River!

RHODE ISLAND: Wainskut Pond, North Providence (*Bailey*); Portsmouth! Nyatt!

18. CLOSTERIUM INCURVUM Bréb.

Closterium incurvum Bréb. Mém. Soc. Sci. Nat. Cherbourg 4: 150. *pl. 2. f. 47.* 1856. — W. & G. S. West, Brit. Desm. 1: 136. *pl. 15. f. 28–30.* 1904.

Cells very small, strongly curved, 5–6 times as long as wide, apices acute; cell-wall colorless, smooth.

Length 62–68 μ; breadth 11–12 μ. (PLATE 3, FIGURE 8.)

NEW HAMPSHIRE: Intervale!

MASSACHUSETTS: Reading! Gibbs and Almanac Ponds, Nantucket!

19. CLOSTERIUM VENUS Kütz.

Closterium Venus Kütz. Phyc. Germ. 130. 1845. — Wolle, Desm. U. S. 44. *pl. 7. f. 6.* 1884. — W. & G. S. West, Brit. Desm. 1: 137. *pl. 15. f. 15–20.* 1904.

Cells small, strongly curved, 8–9 times as long as wide, apices acute; cell-wall colorless and smooth.

Length 56–87 μ; breadth 7–10.5 μ. (PLATE 5, FIGURE 2.)

MAINE: Oldtown (*Harvey*); Kittery!

NEW HAMPSHIRE: Bog near Noone's Station! Mt. Moosilauke, common!

MASSACHUSETTS: Amherst (*W. West*); Winchester! Reading! Wellesley! Wakefield! Lake Watuppa, Fall River! Westport! Cedar Pond, North Falmouth! Nantucket!

RHODE ISLAND: Nyatt!

This is one of our commoner species.

20. CLOSTERIUM EBORACENSE Turner

Closterium eboracense Turner, in Cooke, Brit. Desm. 37. *pl. 65. f. 1.* 1886.—W. & G. S. West, Brit. Desm. 1: 140. *pl. 16. f. 7, 8.* 1904.

Closterium Cucumis Wolle (non Ehrenb.), Desm. U. S. 40. *pl. 6. f. 17, 18.* 1884.

Cells of medium size, 5–6 times as long as wide, outer margin strongly curved, inner margin very slightly concave, apices bluntly rounded; cell-wall colorless and smooth.

Length 248–325 μ; breadth 48–50 μ.

MAINE: Oldtown and Orono (*Harvey*).

MASSACHUSETTS: Amherst (*W. West*); Stony Brook, Weston! Gay Head, Marthas Vineyard!

The specimens reported from America as *C. Cucumis* are as a rule *C. eboracense*, as the work of Wolle was followed by many writers.

21. CLOSTERIUM LEIBLEINII Kütz.

Closterium Leibleinii Kütz. Linnaea 8: 596. *pl. 18. f. 79.* 1834.—Wolle, Desm U. S. 46. *pl. 7. f. 13, 14, 20.* 1884.—W. & G. S. West, Brit. Desm. 1: 141. *pl. 16. f. 9–14.* 1904.

Cells of medium size, strongly curved, 5–6 times as long as wide, apices acutely rounded; cell-wall colorless and smooth.

Length 112–190 μ; breadth 18–34 μ. (PLATE 4, FIGURE 9.)

MAINE: Orono (*W. West*); Kittery!

MASSACHUSETTS: Amherst (*W. West*); South Framingham! Winchester! Myricks! East Bridgewater! Cedar Pond, North Falmouth! Eastham, abundant! Nantucket!

RHODE ISLAND: near Providence (*Bailey*); Nyatt!

22. CLOSTERIUM MONILIFERUM (Bory) Ehrenb.

Lunulina monilifera Bory, Encycl. Meth. Hist. Zooph. **2**: 501. *pl. 3. f. 22, 25, 27.* 1824.

Closterium moniliferum Ehrenb. Infus. 91. *pl. 5. f. 16* (in part). — Wolle, Desm. U. S. 45. *pl. 7. f. 15.* 1884. — W. & G. S. West, Brit. Desm. **1**: 142. *pl. 16. f. 15, 16.* 1904.

C. Leiblcinii Kütz., var. *curtum* West, Jour. Roy. Micr. Soc. **1889**: 17. *pl. 2. f. 8.* 1889.

Cells larger than in the preceding, stout, moderately curved, about 6 times as long as wide, apices obtusely rounded; cell-wall colorless and smooth.

Length 200–325 μ; breadth 31–56 μ. (PLATE 4, FIGURE 10.)

MAINE: Orono (*Harvey*); Gorham (*W. West*); Bridgeton! Spencer Pond, East Middlesex!

NEW HAMPSHIRE: Intervale!

MASSACHUSETTS: Reading! Wakefield! Pondville! Halifax! Lake Watuppa, Fall River! Gay Head, Marthas Vineyard! Nantucket!

RHODE ISLAND: Wainskut Pond, North Providence (*Bailey*).

23. CLOSTERIUM EHRENBERGII Menegh.

Closterium Ehrenbergii Menegh. Linnaea **14**: 232. 1840.—Wolle, Desm. U. S. 45. *pl. 7. f. 16.* 1884.—W. & G. S. West, Brit. Desm. **1**: 143. *pl. 17. f. 1–4.* 1904.

C. robustum Hastings, Am. Month. Micr. Jour. **13**: 154. *pl. 1. f. 4.* 1892.

Cells large, stout, moderately curved, about 4 times as long as wide, apices obtusely rounded; cell-wall colorless and smooth.

Length 400–480 μ; breadth 78–125 μ. (PLATE 4, FIGURE 11.)

MAINE: Near Penobscot River at Great Works and Orono (*Harvey*); Mud Pond, Township 6, Range 12!

NEW HAMPSHIRE: Page Brook, Rochester (*Hastings*).

MASSACHUSETTS: Amherst (*W. West*); Lake Quinsigamond, Worcester (*Stone*); Bridgewater! Watuppa, Fall River! Eastham!

24. CLOSTERIUM ACEROSUM (Schrank) Ehrenb.

Vibrio acerosus Schrank, Fauna Boica 3^2: 47. *no. 2848.* 1803.

Closterium acerosum Ehrenb. Symb. Phys. Phytozoa, *pl. 2. f. 9.* 1828; Infus. 93. *pl. 2. f. 15. pl. 6. f. 1. pl. 22. f. 5.* 1838.

— Wolle, Desm. U. S. 41. *pl. 6. f. 7, 11. pl. 8. f. 17.* 1884.
— W. & G. S. West, Brit. Desm. 1: 146. *pl. 18. f. 2–5.* 1904.

Cells large, elongate, only slightly curved, about 10–12 times as long as wide, gradually tapering to the narrow rounded-truncate apices; cell-wall usually colorless and smooth but in old specimens the cell-wall becomes brownish, sometimes finely striate and the apices thickened just back from the tips.

Length 355–480 μ; breadth 33–42 μ.

MAINE: Orono (*Harvey, W. West*); Mud Pond, Township 6, Range 12!

NEW HAMPSHIRE: Intervale!

MASSACHUSETTS: Lake Quinsigamond, Worcester (*Stone*); Tewksbury (*Lagerheim*); Stony Brook, Weston! Carvers Pond, Bridgewater! Eastham!

24*a*. CLOSTERIUM ACEROSUM ELONGATUM Bréb.

Closterium acerosum, var. *elongatum* Bréb. *l. c.* 152. 1856. — W. & G. S. West, Brit. Desm. 1: 148. *pl. 18. f. 1.* 1904.

Longer and larger than the typical form; cell-wall yellowish-brown with more distinct striations.

Length 500–651 μ; breadth 37–54 μ. (PLATE 4, FIGURE 6.)

MASSACHUSETTS: Amherst (*W. West*); Medford! Lake Watuppa, Fall River! Nantucket!

25. CLOSTERIUM LANCEOLATUM Kütz.

Closterium lanceolatum Kütz. Phyc. Germ. 130. 1845. — Wolle, Desm. U. S. 39. *pl. 8. f. 14.* 1884. — W. & G. S. West, Brit. Desm. 1: 149. *pl. 17. f. 9, 10. pl. 18. f. 7.* 1904.

Cells large 4½–7 times as long as wide, nearly straight, outer margin slightly curved, inner margin often slightly convex, gradually attenuated to the acutely rounded apices; cell-wall colorless, smooth.

Length 390–415 μ; breadth 70–93 μ.

VERMONT: Lake Champlain!

MASSACHUSETTS: Amherst (*W. West*); South Framingham!

RHODE ISLAND: Nyatt!

26. CLOSTERIUM LUNULA (Müll.) Nitzsch

Vibrio Lunula Müll. Naturforsch. 20: 142. 1784.

Closterium Lunula Nitzsch, Neue Schrift. Nat. Gesells. Halle 3: 60,

67. 1817. — Wolle, Desm. U. S. 40. *pl. 50. f. 26.* 1884. — W. & G. S. West, Brit. Desm. **1**: 150. *pl. 18. f. 8, 9.* 1904.

Cells large, stout, 6–7 times as long as wide; axis nearly straight, outer margin curved, inner margin nearly straight, or slightly tumid in the middle, becoming somewhat concave toward the ends, apices often slightly recurved, obtusely rounded; cell-wall colorless, smooth.

Length 465–650 μ; breadth 71–93 μ; apices 12–15 μ. (PLATE 4, FIGURE 18.)

MAINE: Oldtown and Great Works (*Harvey*).

NEW HAMPSHIRE: Pudding Pond, North Conway, common! North Woodstock!

MASSACHUSETTS: Amherst (*W. West*); near Salem (*Bailey*); Misery Island, off Beverly! Reading! Gay Head, Marthas Vineyard!

RHODE ISLAND: Nyatt!

Wolle's figure of this species is not a good one, as he notes.

26*a*. CLOSTERIUM LUNULA INTERMEDIUM Gutw.

Closterium Lunula, var. *intermedium* Gutw. Rozpraw. Wydz. matem.-przyr. Akad. Umiej. Krakow. **32**: 39. *pl. 6. f. 17.* 1897. — W. & G. S. West, Brit. Desm. **1**: 152. *pl. 18. f. 12.* 1904.

Cells with the outer margin more convex, the inner margin broadly convex, ends abruptly narrowed to the truncate apices.

Length 440–540 μ; breadth 65–94 μ.

MASSACHUSETTS: Lake Watuppa, Fall River! Gibbs Pond, Nantucket!

26*b*. CLOSTERIUM LUNULA MINUS W. & G. S. West

Closterium Lunula, forma *minor* W. & G. S. West, Brit. Desm. **1**: 151. 1904.

Smaller than the typical form; the cell-wall faintly straw-colored.

Length 403 μ; breadth 56 μ.

NEW HAMPSHIRE: Intervale!

* 26*c*. CLOSTERIUM LUNULA MAXIMUM Borge

Closterium Lunula, var. *maximum* Borge, Arkiv för Botanik **1**: 77. *pl. 1. f. 9.* 1903.

Cells very large, about four times as long as wide, slightly concave close to the apices, dorsal margin broadly convex, ventral margin slightly tumid.

Length 800 μ; breadth 170 μ. (PLATE 5, FIGURE 7.)

MASSACHUSETTS: Milford Pond, Swansea!

This is one of the largest of our desmids and is visible without a lens.

*27. CLOSTERIUM LITTORALE Gay

Closterium littorale Gay, Monogr. Conj. 75. *pl. 2. f. 17.* 1884.—W. & G. S. West, Brit. Desm. **1**: 155. *pl. 19. f. 14.* 1904.

Cells rather small, about nine times as long as wide, slightly curved, inner margin tumid in the middle, gradually attenuated to the obtusely rounded apices; cell-wall colorless, smooth; zygospore globose and smooth.

Length 160–164 μ; breadth 18–18.5 μ; diameter of zygospore 28 μ. (PLATE 4, FIGURE 8; PLATE 5, FIGURE 12.)

MASSACHUSETTS: Eastham, with zygospores!

This is the first record for the zygospore of this species. New to United States.

28. CLOSTERIUM TUMIDUM Johnson

Closterium tumidum Johnson, Bull. Torrey Club **22**: 291. *pl. 239. f. 4.* 1895. — W. & G. S. West, Brit. Desm. **1**: 156. *pl. 19. f. 15–18.* 1904.

Closterium Cornu, forma *major* West, Jour. Bot. 339. 1888.

Cells rather small, 8–9 times as long as wide, slightly curved, inner margin prominently tumid in the middle, gradually attenuated to the truncately rounded apices; cell-wall colorless, smooth.

Length 130–150 μ; breadth 14–18 μ.

MAINE: Orono (*W. West*).

NEW HAMPSHIRE: Holderness, frequent (*Johnson, W. & G. S. West*); Pudding Pond, North Conway!

29. CLOSTERIUM ABRUPTUM West

Closterium abruptum West, Jour. Roy. Micr. Soc. **1892**: 719. *pl. 9. f. 1.* 1892. — Johnson, Bull. Torrey Club **22**: 291. *pl. 239. f. 5.* 1895. — W. & G. S. West, Trans. Linn. Soc. Bot. II. **5**: 236. *pl. 13. f. 14, 15.* 1896; Brit. Desm. **1**: 158. *pl. 20. f. 6–10.* 1904.

Cells rather small, about 12 times as long as wide, slightly

curved, median portion nearly straight, ends more curved, gradually attenuated to the broadly truncate apices; cell-wall colorless or slightly yellowish-brown, smooth.

Length 84–200 μ; breadth 12.5–15.5 μ; apices 6 μ.

MAINE: Orono (*W. West*).

NEW HAMPSHIRE: Holderness, frequent (*Johnson*).

MASSACHUSETTS: Gibbs Pond, Nantucket!

*30. CLOSTERIUM TOXON West

Closterium toxon West, Jour. Linn. Soc. Bot. **19**: 121. *pl. 19. f. 14.* 1892. — W. & G. S. West, Brit. Desm. **1**: 160. *pl. 20. f. 13, 14.* 1904.

Cells linear, 25 or more times as long as wide, straight with nearly parallel margins, except toward the ends, which are slightly curved, apices subtruncate; cell-wall colorless or a light yellowish-brown, smooth.

Length 242–365 μ; breadth 9–12 μ; apices 4.5–8 μ. (PLATE 4, FIGURE 17.)

MASSACHUSETTS: Lake Watuppa, Fall River! Cedar Pond, North Falmouth!

*31. CLOSTERIUM PRAELONGUM Bréb.

Closterium praelongum Bréb. *l. c.* 152. *pl. 2. f. 41.* 1856.— Wolle(?), F.-W. Alg. U. S. 24. *pl. 55. f. 15, 16.* 1887.— Desm. U. S. 43. *pl. 6. f. 15, 16.* 1892. — W. & G. S. West, Brit. Desm. **1**: 164. *pl. 21. f. 1, 2.* 1904.

Cells very elongate, about 35 times as long as wide, very gently curved, inner margin slightly concave for its entire length, gradually attenuated to the somewhat recurved ends, apices obtuse; cell-wall colorless, smooth.

Length 520 μ; breadth 14 μ; apex 5 μ.

MASSACHUSETTS: Lake Watuppa, Fall River!

Wolle figures a striate form with colored cell-wall under this name. The breadth given is rather large also for this species.

32. CLOSTERIUM STRIGOSUM Bréb.

Closterium strigosum Bréb. *l. c.* 153. *pl. 2. f. 43.* 1856. — Wolle, Desm. U. S. 42. *pl. 6. f. 13, 14. pl. 53. f. 9, 10.* 1884. — W. & G. S. West, Brit. Desm. **1**: 165. *pl. 21. f. 6, 7.* 1904.

Cells of medium size, 12–18 times as long as wide, slightly curved, nearly straight in the middle with the ends more curved, apices subacute; cell-wall colorless, smooth.

Length 170–294 μ; breadth 13–16 μ.

MAINE: Orono (*Harvey*).

NEW HAMPSHIRE: Pudding Pond, North Conway!

MASSACHUSETTS: Amherst (*W. West*); Winchester!

33. CLOSTERIUM GRACILE Bréb.

Closterium gracile Bréb. in Cheval. Microscop. 272. 1839.—Wolle, Desm. U. S. 39. *pl. 6. f. 4, 5.* 1884.—W. & G. S. West, Brit. Desm. **1**: 166. *pl. 21. f. 8–12.* 1904.

C. subtile Harvey, Bull. Torrey Club **19**: 121. 1892.—Cushman, Rhodora **5**: 252. 1903.

Cells small, linear, about 40 times as long as wide, median portion straight with parallel margins, ends gradually attenuated and somewhat curved, apices obtuse; cell-wall colorless and smooth.

Length 172–264 μ; breadth 5–6.2 μ; apices 2.8 μ.

MAINE: Orono (*W. West, Harvey*).

MASSACHUSETTS: Lake Watuppa, Fall River! Misery Island, off Beverly!

RHODE ISLAND: Nyatt!

* 33*a*. CLOSTERIUM GRACILE ELONGATUM W. & G. S. West

Closterium gracile var. *elongatum* W. & G. S. West, Brit. Desm. **1**: 168. *pl. 21. f. 14–16.* 1904.

Cells very elongate, over 100 times as long as wide, otherwise much like the typical.

Length 355 μ; breadth 3.2 μ; apices 1.8 μ.

MASSACHUSETTS: Cedar Pond, North Falmouth!

* 33*b*. CLOSTERIUM GRACILE TENUE (Lemm.) W. & G. S. West

Closterium limneticum Lemm., var. *tenue* Lemm. Phytoplankton Sächsis. Teiche 28. *pl. 2. f. 42–44.* 1899.

C. gracile, var. *tenue* W. & G. S. West, Trans. Linn. Soc. Bot. II. **6**: 138. *pl. 18. f. 22, 23.* 1902; Brit. Desm. **1**: 168. *pl. 21. f. 13.* 1904.

Cells smaller and more slender than in the typical form of the species.

Length 78 μ; breadth 3 μ.

MASSACHUSETTS: Reading!

34. CLOSTERIUM ATTENUATUM Ehrenb.

Closterium attenuatum Ehrenb. Infus. 94. *pl. 6. f. 4.* 1838.—Wolle, Desm. U. S. 41. *pl. 8. f. 5.* 1884.—W. & G. S. West, Brit. Desm. **1**: 169. *pl. 22. f. 1–3.* 1904.

Cells large, about 11 times as long as wide, slightly curved, gradually attenuated toward the ends, where they are suddenly contracted into the obtusely rounded apices; cell-wall reddish-brown in color, with about 20 striae visible across its surface.

Length 465 μ; breadth 45 μ.

MAINE: Frog Pond, Orono (*Harvey*).

NEW HAMPSHIRE: Pudding Pond, North Conway!

35. CLOSTERIUM TURGIDUM Ehrenb.

Closterium turgidum Ehrenb. Infus. 95. *pl. 6. f. 7.* 1838.—Wolle, Desm. U. S. 41. *pl. 6. f. 15.* 1884.—W. & G. S. West, Brit. Desm. **1**: 170. *pl. 22. f. 4, 5.* 1904.

Cells large, somewhat curved, about 13 times as long as wide, ends recurved, apices subtruncate; cell-wall reddish-brown, with 30 or more fine striations visible across the surface.

Length 682 μ; breadth 53 μ; apices 12 μ.

MAINE: Orono (*W. West*).

MASSACHUSETTS: Near Salem (*Bailey*); Lake Watuppa, Fall River!

RHODE ISLAND: Providence (*Bailey*).

* 36. CLOSTERIUM PRITCHARDIANUM Arch.

Closterium Pritchardianum Arch. Proc. Dubl. Nat. Hist. Soc. 3^2: 250. *pl. 12. f. 25–27.* 1862.—W. & G. S. West, Brit. Desm. **1**: 172. *pl. 22. f. 6–14.* 1904.

C. turgidum, forma *intermedium* Cushman, Rhodora **7**: 116. 1905.

Cells large, only slightly curved, about 15 times as long as wide, inner margins nearly straight, ends slightly recurved, apices truncate; cell-wall reddish-brown, with nearly 40 striae, composed of punctae across the surface.

Length 400 μ; breadth 28 μ; apices 7–9 μ. (PLATE 4, FIGURE 5.)

NEW HAMPSHIRE: Intervale!

37. CLOSTERIUM PRONUM Bréb.

Closterium pronum Bréb. Mém. Soc. Sc. Nat. Cherbourg **4**: 157. *pl. 2. f. 42.* 1856.—Wolle, F.-W. Alg. U. S. 25. *pl. 55. f. 22.*

1887; Desm. U. S. 50. *pl. 6. f. 22.* 1892.—W. & G. S. West, Brit. Desm. **1**: 173. *pl. 23. f. 1–3.* 1904.

Cells very elongate, about 50 times as long as wide, nearly straight, very gradually attenuated to the narrow but obtuse apices; cell-wall colorless or slightly yellowish-brown, smooth or with traces of a fine striation in the older specimens.

Length 320–375 μ; breadth 6–8.5 μ.

MAINE: Orono (*W. West*).

NEW HAMPSHIRE: Pudding Pond, North Conway!

*38. CLOSTERIUM ACICULARE T. West

Closterium aciculare T. West, Trans. Roy. Micr. Soc. 8: 153. *pl. 7. f. 16.* 1860.—W. & G. S. West, Brit. Desm. **1**: 174. *pl. 26. f. 18, 19.* 1904.

Cells very elongate, 76 times as long as wide, median portion straight, ends somewhat incurved, attenuated very gradually to the acutely rounded apices; cell-wall colorless, smooth.

Length 380 μ; breadth 5 μ. (PLATE 4, FIGURE 7.)

MASSACHUSETTS: Lake Watuppa, Fall River!

Not previously reported from the United States.

39. CLOSTERIUM ACUTUM (Lyngb.) Bréb.

Echinella acuta Lyngb. Hydr. Dan. 209. *pl. 69. f. G.* 1819.
Closterium acutum Bréb. in Ralfs, Brit. Desm. 177. *pl. 30. f. 5. pl. 34. f. 5, a, b, d–f.* 1848.—Wolle, Desm. U. S. 44. *pl. 7. f. 11, 12.* 1884.—W. & G. S. West, Brit. Desm. **1**: 177. *pl. 23. f. 9–14.* 1904.

Cells small, about 25 times as long as wide, somewhat curved, inner margin not tumid, gradually attenuated to the acute apices; cell-wall colorless, smooth.

Length 150 μ; breadth 6 μ. (PLATE 5, FIGURE 11.)

MAINE: Orono (*W. West*).

MASSACHUSETTS: Amherst (*W. West*); Weston (*W. & G. S. West*); Reading!

*40. CLOSTERIUM SUBULATUM (Kütz.) Bréb.

Frustularia subulata Kütz. Syn. Diat. 538. *pl. 13. f. 1.* 1834.
Closterium subulatum Bréb. in Cheval. Microscop. 272. 1839.—W. & G. S. West, Brit. Desm. **1**: 179. *pl. 23. f. 16–19.* 1904.

Cells small, moderately curved, 12–20 times as long as wide, inner margin slightly tumid, gradually attenuated to the acutely rounded apices; cell-wall colorless and smooth.

Length 133–153 μ; breadth 7–12.5 μ. (PLATE 5, FIGURE 10.)

MASSACHUSETTS: Reading! Randolph! Lake Watuppa, Fall River!

41. CLOSTERIUM LINEATUM Ehrenb.

Closterium lineatum Ehrenb. Infus. 96. *pl. 6. f. 8.* 1838.—Wolle, Desm. U. S. 43. *pl. 6. f. 16.* 1884.—W. & G. S. West, Brit. Desm. 1: 181. *pl. 24. f. 1–5.* 1904.

Cells large, elongated, 15–30 times as long as wide, moderately curved, median portion straight, ends more curved and gradually attenuated to the broad, truncately rounded apices; cell-wall yellowish or reddish-brown, with 12–20 striae across the surface; zygospores usually double, each part ovoid, walls smooth.

Length 540–775 μ; breadth 19–50 μ; apices 6–9 μ; diameter of zygospore 78 μ. (PLATE 4, FIGURE 3.)

MAINE: Scarboro (*W. West*).

MASSACHUSETTS: Near Salem (*Bailey*); Misery Island, off Beverly! Stony Brook, Weston! Cedar Pond, North Falmouth! Lake Watuppa, Fall River!

RHODE ISLAND: Wainskut Pond, North Providence (*Bailey*); Nyatt!

41*a*. CLOSTERIUM LINEATUM COSTATUM Wolle

Closterium lineatum Ehrenb. var. *costatum* Wolle, F.-W. Alg. U. S. 25. *pl. 61. f. 3.* 1887; Desm. U. S. 45. *pl. 10. f. 3.* 1892.—Johnson, Bull. Torrey Club **21**: 286. 1894.

Cells with coarser and fewer costae.

NEW HAMPSHIRE: Rochester (*Wolle*).

CONNECTICUT: Bridgeport (*Johnson, W. & G. S. West*).

*42. CLOSTERIUM RALFSII Bréb.

Closterium Ralfsii Bréb. in Ralfs, Brit. Desm. 174. *pl. 30. f. 2.* 1848.—Wolle, Desm. U. S. 46. *pl. 7. f. 10.* 1884.—W. & G. S. West, Brit. Desm. 1: 182. *pl. 24. f. 6, 7.* 1904.

Cells large, 8–10 times as long as broad, moderately curved, inner margin much inflated for over half the length of the cell, somewhat abruptly attenuated toward the ends, which are somewhat produced and incurved, apices obtuse; cell-wall yellowish or reddish-brown with about 30 striae visible across the surface.

Length 428–496 μ; breadth 52–54 μ; apices 10–12 μ.
MASSACHUSETTS: Lake Watuppa, Fall River!
RHODE ISLAND: Nyatt!

42*a*. CLOSTERIUM RALFSII HYBRIDUM Rabenh.

Closterium Ralfsii, var. *hybridum* Rabenh. Krypt.-Fl. Sachs. 174. 1863. — W. & G. S. West, Jour. Linn. Soc. Bot. **33**: 284. 1898; Brit. Desm. **1**: 183. *pl. 24. f. 8–13.* 1904.

Cells longer than the typical, 13–16 times as long as broad, ventral inflation less prominent, apices subtruncate.

Length 356–682 μ; breadth 24–53 μ; apices 6–15 μ. (PLATE 5, FIGURES 8, 9.)

NEW HAMPSHIRE: Pudding Pond, North Conway!
MASSACHUSETTS: Winchester! Reading! Randolph! Eastham!
CONNECTICUT: Bridgeport (*W. & G. S. West*).

*42*b*. **Closterium Ralfsii immane** var. nov.

Cells similar to *C. Ralfsii*, but larger, very tumid, about 9–11 times as long as wide, rather abruptly attenuated to the rounded apices; cell-wall yellow or reddish-brown, with 30–50 striae across the surface.

Length 610–806 μ; breadth 67–75 μ; apices 11–12 μ. (PLATE 4, FIGURE 4.)

MASSACHUSETTS: Lake Watuppa, Fall River!

43. CLOSTERIUM BRAUNII Reinsch

Closterium Braunii Reinsch, Algenfl. Frank. 196. *pl. 12. f. 5.* 1867. — W. & G. S. West, Trans. Linn. Soc. Bot. **II. 5**: 236. *pl. 13. f. 16, 17.* 1896.

C. areolatum Wood, F.-W. Alg. 111. *pl. 11. f. 6.* 1874.—Wolle, Desm. U. S. 43. *pl. 8. f. 3, 4.* 1884.

C. maculatum Hastings, Amer. Month. Micr. Jour. **13**: 154. *pl. 1. f. 5.* 1892.—Johnson, Bull. Torrey Club **22**: 291. *pl. 239. f. 7.* 1895.

Cells large, very slightly curved or straight, central portion straight, then rather abruptly attenuated to the broadly truncate ends; cell-wall yellowish or reddish-brown, with 10–20 striae or costae, each made up of a double row of elongated granules.

Length 622 μ; breadth 43–50 μ; apices 10–11 μ.
MAINE: Scarboro (*W. & G. S. West*).
CONNECTICUT: Bridgeport, rare (*Johnson*).

44. CLOSTERIUM INTERVALICOLA Cushman

Closterium intervalicola Cushman, Rhodora **7**: 115. *pl. 61. f. 1.* 1905.

Cells rather small, about 10–12 times as long as wide, median portion nearly straight, but the ends decidedly curved, very slightly attenuated to the squarely truncated apices; cell-wall yellowish-brown with about 6 coarse striae across the surface.

Length 168 μ; breadth 15.5 μ; apices 6 μ. (PLATE 5, FIGURE 5.)

NEW HAMPSHIRE: Intervale!

*45. **Closterium Novæ-Angliæ** sp. nov.

Cells large, very elongate, 30–35 times as long as wide, very slightly curved, median portion straight, gradually attenuated to the incurved ends, ventral margin slightly tumid for a large part of its course near the middle, apices obtusely rounded; cell-wall yellowish or reddish-brown with a thickening and consequent darkening at the apices, 6–8 striae across the surface changing to granules near the apices.

Length 930–1080 μ; breadth 28–30 μ; apices 9–11 μ. (PLATE 4, FIGURE 1.)

MASSACHUSETTS: Lake Watuppa, Fall River!

This is one of the longest species recorded for this genus, being exceeded slightly by *C. mourense* Playfair, which is however 3–4 times as wide. This is near *C. Calamus* Playfair.

46. CLOSTERIUM DECORUM Bréb.

Closterium decorum Bréb. Mém. Soc. Sci. Nat. Cherbourg **4**: 151. *pl. 2. f. 39.* 1856.—Wolle, Desm. U. S. 43. *pl. 7. f. 1.* 1884.—W. & G. S. West, Brit. Desm. **1**: 184. *pl. 17. f. 7, 8.* 1904.

C. Delpontei Wolle, Bull. Torrey Club **12**: 2. 1885; F.-W. Alg. U. S. 25. *pl. 55. f. 9.* 1887; Desm. U. S. 45. *pl. 6. f. 9.* 1892.

Cells large, 12–16 times as long as wide, median portion of inner margin tumid, outer margin moderately curved, gradually attenuated to the truncately rounded apices; cell-wall yellowish-brown, with 15–18 striae across its surface.

Length 325–540 μ; breadth 24–48 μ; apices 6–9 μ. (PLATE 4, FIGURE 2.)

MAINE: Scarboro (*W. West*).

NEW HAMPSHIRE: Pudding Pond, North Conway! North Woodstock!

MASSACHUSETTS: Halifax! Lake Watuppa, Fall River! Gay Head, Marthas Vineyard! Gibbs Pond, Nantucket!

CONNECTICUT: Bridgeport and Easton (*Johnson, W. & G. S. West*).

47. CLOSTERIUM KÜTZINGII Bréb.

Closterium Kützingii Bréb. *l. c.* 156. *pl. 2. f. 40.* 1856.—Wolle, Desm. U. S. 47. *pl. 8. f. 8.* 1884.—W. & G. S. West, Brit. Desm. 1: 186. *pl. 25. f. 6–11.* 1904.

Cells of medium size, 18–26 times as long as broad, nearly straight, median portion of cell fusiform, both margins of about the same convexity, attenuated at each end into long colorless processes, apices slightly incurved, rounded and slightly enlarged; cell-wall colorless or light yellowish-brown with 10–15 striae visible across the cell.

Length 325–460 μ; breadth 13–22 μ; apices 2.5–3 μ. (PLATE 4, FIGURE 13.)

MAINE: Pushau Stream (*Harvey*).

NEW HAMPSHIRE: Pudding Pond, North Conway! Hills Pond, Alton!

MASSACHUSETTS: Winchester! Randolph! Bridgewater! Lake Watuppa, Fall River! Westport! Cedar Pond, North Falmouth!

48. CLOSTERIUM ROSTRATUM Ehrenb.

Closterium rostratum Ehrenb. Phys. Abh. Akad. Wiss. Berlin 67. 1833.—Wolle, Desm. U. S. 46. *pl. 8. f. 1–3.* 1884.—W. & G. S. West, Brit. Desm. 1: 188. *pl. 26. f. 1–5.* 1904.

Cells of medium size, 14–18 times as long as wide, slightly curved, median portion fusiform, inner margin more convex than the outer, attenuated at each end into long slightly incurved processes, shorter than in the preceding, ends slightly enlarged; cell-wall yellowish-brown with 25 or more striae across the surface.

Length 360–420 μ; breadth 19–25 μ; apices 3–4.5 μ. (PLATE 4, FIGURE 14.)

MAINE: Between Orono and Bangor (*W. West*); Pushau Pond (*Harvey*).

MASSACHUSETTS: Amherst (*W. West*); Bridgewater! Pondville! Lake Watuppa, Fall River!

48a. CLOSTERIUM ROSTRATUM BREVIROSTRATUM West

Closterium rostratum, var. *brevirostratum* W. West, Jour. Roy. Micr. So. 1889: 17. *pl. 2. f. 9.* 1889.—W. & G. S. West, Brit. Desm. 1: 189. *pl. 26. f. 6–8.* 1904.

Cells with shorter and less attenuated apices.

MASSACHUSETTS: Amherst (*W. West*).

49. CLOSTERIUM SETACEUM Ehrenb.

Closterium setaceum Ehrenb. Infus. 97. *pl. 6. f. 9.* 1838.—Wolle, Desm. U. S. 47. *pl. 8. f. 6, 7, 9–11.* 1884.—W. & G. S. West, Brit. Desm. 1: 190. *pl. 26. f. 9–13.* 1904.

Cells small, very slender, nearly straight, 35–45 times as long as wide, median portion fusiform, both margins equally convex, extremities prolonged, very slender; cell-wall colorless or slightly yellowish-brown, with about 12 or 13 fine striations across the surface; zygospore cruciform.

Length 235–465 μ; breadth 6–10 μ; apices 1–2.3 μ. (PLATE 4, FIGURES 15, 16.)

MAINE: Spencer Pond, East Middlesex!

NEW HAMPSHIRE: Pudding Pond, North Conway!

MASSACHUSETTS: Near Salem (*Bailey*); Reading! Randolph! Bridgewater, zygospores! Halifax! Lake Watuppa, Fall River! Nantucket!

RHODE ISLAND: Providence (*Bailey*); Nyatt!

The following forms of *Closterium* are not included in the above records:

"CLOSTERIUM DECUSSATUM Kg."

Recorded by Wolle from Gilder and other ponds on Mt. Everett, Mount Washington, Mass. What Wolle had is a perplexing thing, as I collected in Gilder Pond in 1907 and failed to find anything corresponding to many of the forms described by Wolle from that locality.

CLOSTERIUM NASUTUM Nordst.

Recorded by Wolle from "Ponds, Berkshire Mountains, Massachusetts." I have failed to find anything corresponding to this species.

CLOSTERIUM SUBANGUSTATUM West

This was described from Maine, "Bog between Orono and Bangor." It is close to some forms of *C. angustatum*, var. *clavatum* Hastings.

BOSTON SOCIETY OF NATURAL HISTORY.

Explanation of plates 3–5

PLATE 3

FIG. 1. *Closterium Cynthia* De Not. ×450.

" 2. " " " zygospore, ×450.

FIG. 3. *Closterium Archerianum* Cleve, × 350.
" 4. " *Malmei* Borge, × 200.
" 5. " " " apex, × 600.
" 6. " *parvulum* Näg. × 350.
" 7. " " " × 300.
" 8. " *incurvum* Bréb. × 300.
" 9. " *Ulna* Focke, × 350.
" 10. " *striolatum* Ehrenb. × 350.
" 11. " " *erectum* Klebs, × 350.
" 12. " *angustatum clavatum* Hastings, × 160.
" 13. " *costatum* Corda, × 250.
" 14. " " *Westii* Cushman, × 300.
" 15. " *regulare* Bréb. × 250.
" 16. " *didymotocum* Corda, × 350.
" 17. " *macilentum* Bréb. × 350.
" 18. " *juncidum* Ralfs, × 350.
" 19. " " *brevius* Roy, × 350.

PLATE 4

FIG. 1. *Closterium Novae-Angliae* sp. nov. × 125.
" 2. " *decorum* Bréb. × 350.
" 3. " *lineatum* Ehrenb. × 250.
" 4. " *Ralfsii immane* var. nov. × 225.
" 5. " *Pritchardianum* Arch. × 300.
" 6. " *acerosum elongatum* Bréb. × 150.
" 7. " *aciculare* T. West, × 250.
" 8. " *littorale* Gay, × 350.
" 9. " *Leibleinii* Kütz. × 300.
" 10. " *moniliferum* (Bory) Ehrenb. × 300.
" 11. " *Ehrenbergii* Menegh. × 250.
" 12. " *Dianae* Ehrenb. × 300.
" 13. " *Kützingii* Bréb. × 300.
" 14. " *rostratum* Ehrenb. × 300.
" 15. " *setaceum* " × 300.
" 16. " " zygospore, × 350.
" 17. " *Toxon* West, × 350.
" 18. " *Lunula* (Müll.) Nitzsch, × 125.

PLATE 5.

FIG. 1. *Closterium Pseudodianae* Roy, × 300.
" 2. " *Venus* Kütz. × 400.
" 3. " *Jenneri* Ralfs, × 350.
" 4. " " " × 450.
" 5. " *intervalicola* Cushman, × 300.
" 6. " *didymotocum* Corda, × 200.
" 7. " *Lunula maximum* Borge, × 125.
" 8. " *Ralfsii hybridum* Rabenh. × 150.
" 9. " " " " tip, × 450.
" 10. " *subulatum* (Kütz.) Bréb. × 450.
" 11. " *acutum* (Lyngb.) Bréb. × 400.
" 12. " *littorale* Gay, zygospore, × 400.

New ferns described as hybrids in the genus Dryopteris

PHILIP DOWELL

During the past five years I have been interested in the study of our native ferns in the field; and in our woodland swamps on Staten Island, and elsewhere in the vicinity of New York, I have occasionally met with forms that are not referable to any one recognized species but have characteristics in common with two known species. I do not refer to sports or mutants, which I have found also, and which can usually be referred definitely to some one species. The most plausible explanation in the case of these ferns is that they are hybrids, or that they have at least originated as hybrids between the two species whose characteristics they share, and as such they are here described in accordance with our American code. At all events they are new and deserve to be described and named. It should be borne in mind that these ferns grow in moist woodlands or in swampy places, where the conditions are favorable for the mingling of the gametes, and that natural hybrids may thus be easily produced. This was mentioned in *Torreya* 6: 208, 1906, in an article entitled "Observations on the Occurrence of Boott's Fern," although at that time I was rather skeptical about hybrids among ferns. That hybrids do occur among ferns has been experimentally proved by Miss Margaret Slosson and others. By selecting and manipulating the prothallia with their antheridia and archegonia, Miss Slosson produced a hybrid between *Dryopteris cristata* and *D. marginalis* which looks the same as the natural hybrid described by G. E. Davenport as *D. cristata* × *marginalis*. Miss Slosson produced also, in a similar manner, a hybrid resembling *Asplenium ebenoides* Scott. In his "Index Filicum" Carl Christensen recognizes a number of hybrids, of which he includes three or four in the genus *Dryopteris*, four if we include *D. pittsfordensis*, of which he is not certain, but which is undoubtedly *D. marginalis* × *spinulosa*, as suggested by Miss Slosson when she described it. The other three recognized in the Index Filicum are *D. Filix-mas* × *spinulosa* (A. Br.) C. Chr., *D. cristata* × *marginalis*

Dav., and *D. cristata* × *spinulosa* (Milde) C. Chr. The last has been considered by many botanists the same as our Boott's fern, but Christensen puts this as doubtful, and in my opinion they are not the same.

DRYOPTERIS CRISTATA × SPINULOSA (Milde) C. Chr.

Aspidium cristatum × *spinulosum* Milde, Nova Acta Acad. Leop.-Carol. **26**: 533. 1858.

Dryopteris cristata × *spinulosa* C. Chr. Index Filicum 259. 1905.

Of this fern I have collected specimens near Suffern, N. Y., *3927b*, July 23, 1905, and *5273*, October 6, 1907, Ocean Terrace, Staten Island, *3994a*, August 2, 1905, and *5013*, July 15, 1907; Bulls Head, Staten Island, *4380a*, June 10, 1906, and *5053*, July 24, 1907.

This differs from Boott's fern in having glabrous indusia, sori farther from the midvein, in being less deeply cut, having the stipes less chaffy, and the scales a paler brown.

Dryopteris cristata × intermedia nom. nov.

Aspidium Boottii Tuckerm. Hovey's Mag. **9**: 145. 1843.

Aspidium spinulosum Boottii D.C. Eaton in A. Gray, Man. ed. 5, 665. 1867.

Dryopteris Boottii Underw. Our Native Ferns, ed. 4, 117. 1893.

This occurs frequently in our woodland swamps.

The probability that this fern is a hybrid has been often stated and commented upon, and by many the opinion is held that it is a hybrid between *D. cristata* and *D. spinulosa*, as stated above. It differs from that fern in being more deeply cut, usually bipinnate, more chaffy at the base of the stipe, having the scales darker, the indusia and the under side of the blade glandular, and the sori nearer the midvein.

Dryopteris Clintoniana × intermedia hyb. nov.

Rhizome stout, chaffy: stipes 10–40 cm. long, densely chaffy at the base with thin light-brown scales, which have usually a darker center; blades ovate-lanceolate to oblong-lanceolate, 20–75 cm. long, 15–25 cm. wide, acuminate at the apex, slightly narrowed at the base, pinnate-pinnatifid to twice pinnate; pinnae oblong-lanceolate to triangular-lanceolate, acuminate, broadest at the base, the upper pinnatifid, the lower pinnate toward the base

in the fertile fronds; pinnulae 10–15 pairs, linear-oblong to oblong, acute or obtuse, somewhat falcate, serrate or the lower incised, the lobes spinulose-toothed with appressed teeth; sori nearer the midvein than the margin, indusia thin, reniform, glandular, not large.

In general appearance this fern resembles the Clinton fern more than the other, but it differs from that fern in the deeper cutting of its pinnae and in having glandular indusia, which are also smaller. It differs from *D. intermedia* in its more elongate shape, in the greater difference between its sterile and fertile fronds, in being less cut or divided, and in having the sori nearer the midvein. It resembles Boott's fern, *D. cristata* × *intermedia*, more than it does any other. This is to be expected when we consider that they have one parent species in common and the other (*D. cristata* and *D. Clintoniana*) so closely allied that most botanists have heretofore placed one as a variety of the other. It differs from Boott's fern in being usually larger, wider in proportion to the length, being less deeply cut, having the pinnulae more falcate, the teeth more incurved or appressed, and the sori nearer the midvein. In the type locality and near Cornwall, Conn., vigorous plants of this fern were not rare. In the type locality I should call it fairly abundant, as abundant as Boott's fern, which grows in luxuriance in that locality. It was found associated with the alleged parent species in the following localities, except Bulls Head, where I have found only one plant of this fern and no plant of *D. Clintoniana*.

NEW JERSEY: Swamp above Lake Macopin, near Newfoundland, September 3, 1906, *Dowell 4606*, type; July 27, 1907, *5069*.

NEW YORK: Suffern, July 23, 1905, *Dowell 3928*, October 6, 1907, *5269*; Bulls Head, Staten Island, August 3, 1905, *3995*; Richmond, August 17, 1905, *4049*.

CONNECTICUT: Cornwall, July 4 and September 10, 1907, *R. C. Benedict 72* and *267*.

Dryopteris Clintoniana × Goldiana nom. nov.

Dryopteris Goldicana celsa Palmer, Proc. Biol. Soc. Wash. **13**: 65. 1899.

Rhizome thick, chaffy: stipes 20–50 cm. long, densely chaffy at the base with thin light-brown scales having a darker center, or

with some thick dark-brown elongated scales; blades pinnate pinnatifid, acuminate, the sterile triangular-ovate to ovate-lanceolate, 20–50 cm. long, 15–25 cm. wide, fertile blades ovate-lanceolate to oblong-lanceolate, narrowed at the base, 40–80 cm. long, 20–35 cm. wide; pinnae deeply incised, sometimes divided at the base, ovate-lanceolate to oblong-lanceolate, acuminate, in some fronds the upper broadest at the base while the lower are narrowed at the base, in other fronds the lower broadest at the base while the middle and upper ones are broadest near the middle; pinnulae or lobes of the pinnae 10–20 pairs, oblong to oblong-linear, obtuse or acutish, falcate, appressed-serrate or those of the lower pinnae slightly incised; sori near the midvein, indusia thin, glabrous.

In general appearance this fern resembles the Clinton fern, with which it has been placed by some, while others have referred it to the Goldie fern. It differs from the former in having some of the thick dark-brown scales characteristic of the latter, and in having some of the pinnae narrowed at the base.

It differs from the Goldie fern in having fewer of the thick dark scales; the fronds usually more narrow, more gradually tapering, and more narrowed at the base; the basal pinnulae longest on a portion of the frond, the upper in some, the lower in others.

NEW YORK: Swamp near South Avenue, Staten Island, October 9, 1904, *Dowell 3558*, type; low woods, Lower Genesee, near Rochester, *W. H. Lennon*, June 16, 1895.

NEW JERSEY: Springdale, near Newton, *Dowell 4929* and *5033*, July 4 and 22, 1907.

VERMONT: Swamp near Willoughby Lake House, August 21, 1896, "ex herb. *E. & C. E. Faxon.*"

NORTH CAROLINA: Chapel Hill, September 1907, *W. C. Coker.*

VIRGINIA: Dismal Swamp, June 8, 1899, *William Palmer 247 i*, *j*, and *k*, labeled "*D. Goldieana celsa*, paratype." This last was reported as growing on logs, the others grew in the soil.

Dryopteris Goldiana × intermedia hyb. nov.

Fronds 7.5–12 dm. long, about 3 dm. wide: stipes 25–40 cm. long, densely chaffy at the base with thick dark-brown linear-lanceolate scales and thin membranous scales, the latter extending on the rachis; blades 50–75 cm. long, about 30 cm. wide, ovate

to oblong, bipinnate; pinnae oblong to oblong-lanceolate, mostly broadest toward the middle, the lowest unequally ovate-lanceolate, those near the middle of the blade most divided; pinnulae oblong or lanceolate, falcate, acute, large, incised, the lobes spinulose-toothed; sori slightly nearer the midvein than the margin, nearly terminal on the veinlets; indusia thin, glandular, not large, intermediate in cell-structure between those of *D. Goldiana* and *D. intermedia.*

In general appearance this fern looks like a large overgrown *D. intermedia*, but it differs from this in having the thick dark scales characteristic of *D. Goldiana* and the sori nearer the midvein. It differs from the Goldie fern in the cutting of the frond and in having glandular indusia, while it resembles this fern in its shape and size, in the shape of its pinnae and the falcate shape of the pinnulae, and in the character of its scales.

Type specimens are in the herbarium of the New York Botanical Garden, collected by Professor L. M. Underwood, August, 1899, near Jamesville, New York, in a locality abounding in *D. intermedia* and having occasional patches of *D. Goldiana.*

Dryopteris Goldiana × marginalis hyb. nov.

Rhizome short, thick, densely chaffy: fronds erect or ascending, 5–11 dm. tall; stipe 20–35 cm. long, densely chaffy at the base with thick dark-brown linear-lanceolate scales mixed with thin membranous scales, the latter extending on the rachis; blade bipinnate, abruptly acuminate, the sterile triangular-ovate to ovate-lanceolate, 15–50 cm. long, 10–20 cm. wide, pinnate-pinnatifid; the fertile ovate-lanceolate to oblong-lanceolate, 30–75 cm. long, 20–35 cm. wide, bipinnate; pinnae ovate-lanceolate to oblong-lanceolate, long-acuminate, broadest toward the middle; pinnulae oblong to oblong-linear, falcate, acute or obtuse, serrate or incised, decurrent on the rachis, those on the lower side of the basal pinnae sometimes conspicuously elongated; sori about midway between the margin and the midvein, or nearer the margin, indusia firm, glabrous, not large.

In general appearance, as well as in detailed characteristics, this fern is intermediate between its alleged parents. Large fronds suggest *D. Goldiana* in appearance while the smaller look like *D. marginalis*, but all the specimens and the several plants examined showed scales characteristic of both species, their sori are intermediate in position, and the indusia intermediate in character. Its

relationship to the Goldie fern is established by the presence of the unmistakable dark elongated scales, while its relationship to the marginal fern is shown by the character of the indusium and the shape and color of the frond,—the characteristic dark bluish-green upper surface and the glaucous appearance of the under side. It differs from the latter by its larger size, by its thick dark-brown scales, and by the position of the sori away from the margin. It differs from the Goldie fern in having the fertile fronds bipinnate, in the greater difference in color between the two surfaces of the frond, in having thicker indusia and the sori midway between the midvein and margin.

About a score or more plants of this fern were found along the edge of a large swamp west of Springdale, near Newton, New Jersey, on July 4, 1907, *Dowell 4931*, type. On July 22 another plant (*no. 5035*) of this fern was found in a different part of the swamp. The marginal fern is common and the Goldie fern is occasional along the edge of the swamp.

Most of the specimens cited above are in the herbarium of the New York Botanical Garden.

In conclusion I may add that this paper is not intended primarily as a contention or a defense for the theory of hybridity. The principal points on which I base my opinion that these ferns are hybrids, may be summed up briefly as follows: Each fern has characteristics common to two species and cannot be referred to any one previously described species alone, except in the case of Boott's fern, which has been described as a species; they have a tendency to be sterile, the sporangia being largely abortive; they occur only occasonially, and rarely in large numbers in any one locality; they grow in places favorable for the mingling of the gametes; they are found usually associated with the supposed parent species; hybrids among ferns have been experimentally produced, and are known to exist.

PORT RICHMOND, N. Y.

The correlation of flower- and fruit-structure in Carica Papaya

P. J. Wester

The papaya (*Carica Papaya* L.) is a small tree, — dioecious, or rarely bearing perfect flowers. The normal staminate flower is funnel-shaped with a long slender tube, the lobes being shorter than the tube and with ten anthers inserted in the throat of the corolla, the pistil being abortive. The normal pistillate flower is larger than the staminate and has distinct petals and a sessile ovary, which is large, round or angular, and contains numerous ovules. The stigma is sessile and five-rayed, with rays ultimately branched to six or more flattened lobes, and the stigmatic area extending a short distance around upon the dorsal surface (FIG. 1, *a*; for the sake of clearness only one of the five rays is shown).

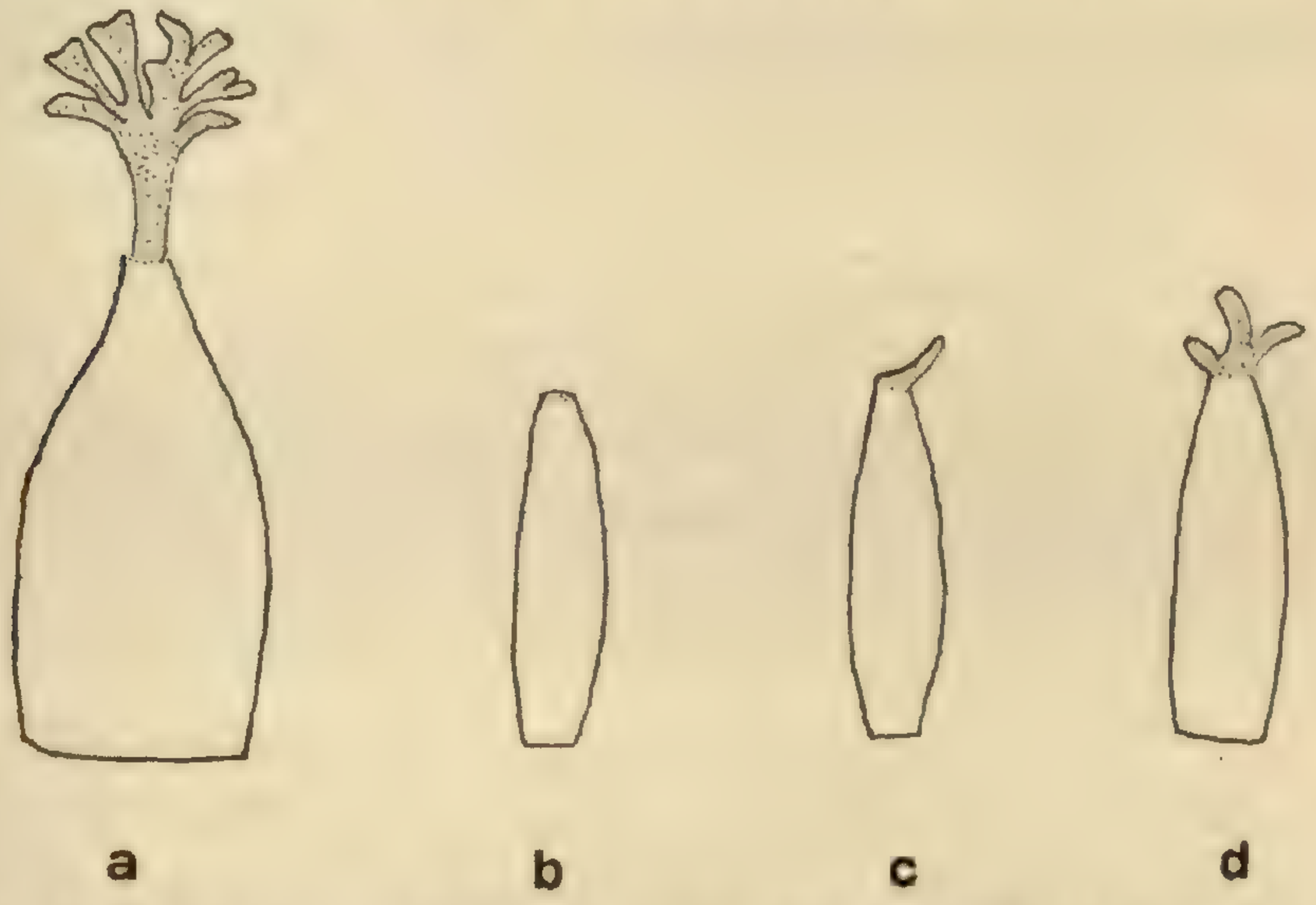


FIG. 1. Pistils of *Carica Papaya* showing different forms of stigma. (Enlarged about 1/5.)

During the summer of 1904 the attention of the writer was called to a rather unusual difference in the shape and size of the individual fruits on a papaya growing in the garden of the Sub-tropical Laboratory. The plant, being old, ceased to bear in the autumn and died later, but a cutting had fortunately been rooted successfully during the summer, and was planted out in the winter. Recalling the interesting fruits noted on the parent tree,

the development of this plant was watched with great interest. In July, 1905, the first flowers appeared. For several weeks all blossoms were staminate. In August several hermaphrodite flowers opened, which are rather rare in this species. By far the greater number of the flowers were staminate, but as the plant grew larger, quite a number of perfect flowers appeared in the axil of every leaf. On examination it was found that the structure of these flowers varied to a remarkable degree. Three distinct types of flowers were easily recognized: (1) those resembling a pistillate flower more than a staminate, large, tube one-half as long as lobes, anthers inserted in the throat of corolla, ovary large, angular, stigmatic end superior to anthers, ovules numerous, stigma normal; (2) those with the characters of both the staminate and pistillate flowers equally present, tube longer than in the type described above, ovary not so large, one or more of the stigmatic rays abortive, in some instances only a rudimentary ray being present (FIG. 1, *c* and *d*): (3) flowers approaching more closely a staminate flower in structure than either of the two classes mentioned, having the tube and lobes of equal length, ovary small, slender, ovules few, stigma reduced to a stigmatic area at the apex of the ovary (FIG. 1, *b*), inferior to or level with the anthers. It was noted also that the pollen masses were released just before or about when the flowers opened where it was inferior to or on a level with the anthers and in some instances, at least, where this organ was superior to the anthers.

In order to determine whether the development and formation of the fruit might be correlated with the structure of the flower, a series of notes was taken upon a number of flowers all on the same tree. In most instances the bisexual flower-buds were bagged with small paper sacks before they opened, the sack being retained until the flower had faded and the ovary was beginning to develop. Numerous small black ants frequent the flowers of the papaya to get the honey secreted, and to prevent a possible cross-pollination by these insects a broad band of cotton was tied around the trunk of the plant, which prevented their ascent. It may be mentioned here that bees or other large flying insects do not seem to act as fertilizing agents in this species, the pollen evidently being carried by the wind, or, more probably, by small insects, from the stami-

nate flowers to the pistillate. All the male flower-buds on the plant were picked before they opened to prevent a possible conveyance of pollen from them by the wind to the flowers not bagged. Twenty-three flowers were numbered as they opened and the differences in their structure noted. Seven of these were not bagged. Of the flowers that did not set fruit, two had small ovaries with stigma reduced to a stigmatic area at the apex of the ovary, one of these two not being bagged. Five fruits were injured by insects so that they dropped or ripened prematurely and one was cut to give the other fruits more room. The first fruit was picked April 23, 1906, and the last June 26. As they were tested each fruit was weighed then cut through the center longitudinally with a sharp knife and an outline of the fruit and cavity traced on a paper. The dried seed from each fruit was also weighed. That the hermaphrodite flowers do not need external aid in pollination and that they are fertile with their own pollen was fully demonstrated, as in no instance were the flowers hand-pollinated. The chances that the unbagged flowers were fertilized by the wind were also exceedingly slight, as no male plants were growing in the vicinity. The supposition that the characters of the flower might be correlated with the form and size of the fruit was fully borne out and is best illustrated in the accompanying photograph (FIG. 2) of the tracings of six fruits. By referring to the following notes corresponding to the numbers above the outlined fruits it will be seen that where the ovary was small and slender, with rays in the stigma nearly aborted, the fruits grew comparatively small, cylindrical and oblong, almost solid, with exceedingly small seed-cavity containing few seeds, while where the pistil was normal, or nearly so, the fruits grew large, more or less angular, with the apical end distended, and the cavity containing a large number of seeds.

Unfortunately, no fruits matured from flowers where the stigma was rayless, as the fruits dropped, being injured by insects. The following notes all refer to hermaphrodite flowers:

No. 2. October 5, 1905. Flower bagged; tube long; ovary slender; stigma reduced to stigmatic area at apex of ovary with one short ray like FIGURE 1, *c*; mature April 23; weight of fruit 600. grams; seed-cavity small; weight of dried seeds 2 grams. (FIGURE 2, no. 2.)

No. 4. October 7, 1905. Flower not bagged; tube long; ovary slender; stigma reduced to stigmatic area at apex of ovary with short ray like FIGURE 1, *c*; mature April 23; weight of fruit 345 grams; seed-cavity very small, containing few seeds; weight of dried seed one gram. (FIGURE 2, no. 4.)

No. 7. October 10, 1905. Flower bagged; tube long; ovary slender; stigma reduced to stigmatic area at apex of ovary with three short rays, about like FIGURE 1, *d*; fruit mature April 23; weight of fruit 520 grams; seed-cavity small, containing few seeds; weight of dried seed 2 grams. (FIGURE 2, no. 7.)

No. 15. October 17, 1905. Flower bagged; tube short; ovary large and angular; stigma normal like FIGURE 1, *a*; fruit mature May 8; weight of fruit 2115 grams; seeds numerous and more than lining cavity; weight of dry seed 15 grams. (FIGURE 2, no. 15.)

No. 16. October 18, 1905. Flower bagged; tube short; ovary very large and angular; stigma normal like FIGURE 1, *a*; fruit mature May 31; weight of fruit 1620 grams; cavity well filled with seed; weight of dried seed 15 grams. (FIGURE 2, no. 16.)

No. 17. October 18, 1905. Flower bagged; tube short; ovary very large and angular; stigma 4-rayed, otherwise normal; fruit mature June 6; weight of fruit 1920 grams; weight of dried seed 16 grams. (FIGURE 2, no. 17.)

The fruits developed from flowers in which the stigmatic rays were almost entirely abortive contained several undeveloped ovules, and the fruits were smaller than those developed from flowers where the stigmatic area was large. No. 14, flower bagged, was an interesting exception. The flower to this fruit was similar to that of no. 15. On maturity the fruit weighed 580 grams. Of a large number of ovules very few had developed to seed, which, dried, weighed only 0.75 gram. The general outline of the fruit was similar to that of no. 15 and the seed-cavity was proportionately as large. It is possible that the inferior size of this fruit may have been due to imperfect pollination, so many ovules having failed to develop, and it may partly be the cause of the small size of nos. 2, 4, and 7 also, although it is believed that a difference in the structure of the pistil is the greatest factor in determin-

ing the growth and development of the fruits, in view of the fact that the number of ovules is small and the wall of the ovary thick where the stigma is small, while the number of ovules is great and the cavity large and the ovary wall thin where the stigmatic area is large.

The seed from the different fruits was saved and planted in 1906. A large number of these seedlings perished, unfortunately, in the hurricane in October and the severe freeze of December the same year. Of those that survived a very much larger number proved to be hermaphrodite plants than is the case with seedlings grown from fruits commonly found in the market.

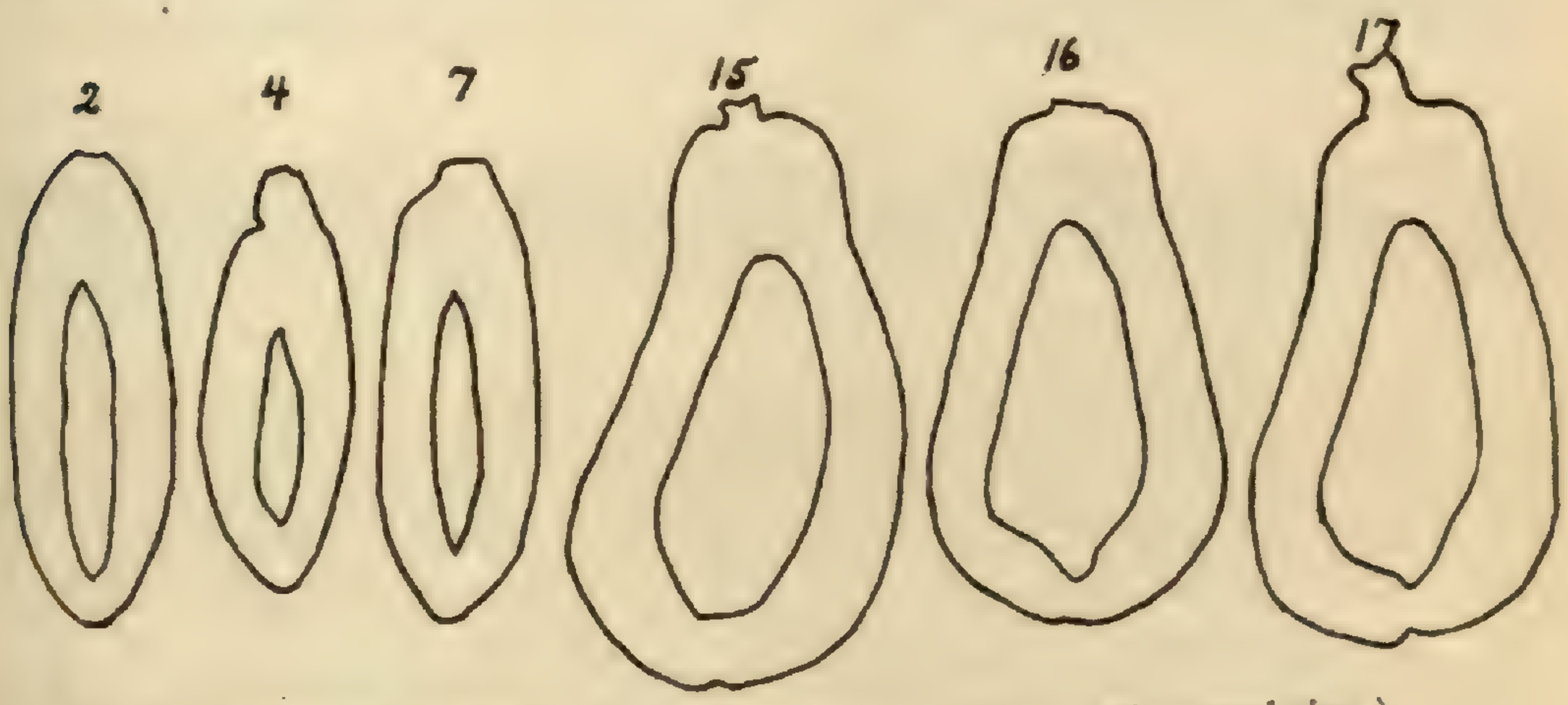


FIG. 2. Outlines of fruits of *Carica Papaya*. (About 1/6 natural size.)

Since the above notes were made, the flowers on a large number of papaya plants have been examined. Few hermaphrodite plants are found, but, in all trees bearing bisexual flowers that have been noted, the variation in the structure of the flowers, as stated above, has been recorded.

The papaya, as commonly propagated at present, has too large a percentage of worthless seedlings to be commercially profitable. Good material for cuttings is, from the nature of the tree, difficult to obtain and is so difficult to root without bottom heat — seldom or never used in rooting plants in the tropics or subtropics — that this mode of propagating a good variety does not commend itself. It has been demonstrated at the Subtropical Laboratory that inarching can be done, but this is necessarily a slow and cumbersome method of propagation.

An attempt to originate a variety of papaya by inbreeding

would probably be more successful if the flowers were hand-pollinated with their own pollen than if pollination were accomplished with pollen from flowers differing in structure. It seems quite probable that in a batch of seedlings grown from an individual fruit with small seed-cavity and few seeds — the flowers of course being bisexual — some seedlings would have a greater percentage of flowers that would develop this type of fruit, which would be preferable commercially to fruits with large cavities containing numerous seeds. It is probable that by inbreeding and rigid selection for several generations a variety of papaya bearing all its fruits of this type might be originated, which, the flowers being self-pollinated, would reproduce itself true to the variety.

SUBTROPICAL LABORATORY, MIAMI, FLORIDA.

Sorosporium Ellisii Winter, a composite species

H. S. Jackson

In October, 1907, the writer collected a *Sorosporium* on *Aristida dichotoma* in the vicinity of Newark, Delaware, and found on examination that it agreed with specimens on the same host referred to *Sorosporium Ellisii* Winter. An examination of the specimens in Ellis & Ev. N. A. Fungi, led me to believe that *Sorosporium Ellisii* as described by Winter was a composite species.

Winter based his *Sorosporium Ellisii* on two collections sent him by Mr. J. B. Ellis. One of these collections was made by Mr. Ellis on *Andropogon virginicus* at Newfield, N. J., Oct., 1880; the other on *Aristida dichotoma* by Mr. Wm. Trimble in Chester Co., Pa., Sept., 1880, and communicated to Mr. Ellis by Dr. Martin. Recently I had the opportunity of examining material in the Ellis and other collections in the herbarium of the New York Botanical Garden, and became convinced that the form on *Andropogon* is specifically distinct from the one on *Aristida*.

In separating these two forms into species, the question arises as to which shall be quoted as the type of *Sorosporium Ellisii*. The original description appeared simultaneously in Hedwigia **22**: 2. Ja 1883, and in Bull. Torrey Club **10**: 7. Ja 1883. In Hedwigia, *Aristida* is the first host mentioned, while in the Bulletin of the Torrey Botanical Club, *Andropogon* is mentioned first. It is seen that as far as the original description is concerned neither specimen can be said to have priority. As to the date of collection, the form on *Aristida* was collected in September, 1880, while that on *Andropogon* was taken in October, 1880, as is shown by the data on the envelopes in the Ellis collection. This fact might lead some mycologists to give precedence to the form on *Aristida*. However, Winter named his fungus in honor of Ellis, and it seems proper to consider the specimen collected by Ellis as the type.

Sorosporium Ellisii Winter, therefore, should refer to the form on *Andropogon*, which has the following distribution:*

On Poaceae:

Andropogon virginicus L. New Jersey.

Andropogon scoparius Michx. Connecticut, Illinois, Kansas.

TYPE LOCALITY: Newfield, N. J., on *Andropogon virginicus* L.

EXSICCATI: Seym. & Earle, Econ. Fungi *C 38*; Ellis & Ev. N. A. Fungi *1099*.

The two specimens of the original collections on *Andropogon* and *Aristida* are marked (probably by Ellis) *Sorosporium Ellisii* Winter f. *Andropogonis* and f. *Aristidae* respectively. The name *Sorosporium Aristidae* is, however, untenable.† The following name with description is proposed for the form on *Aristida*.

Sorosporium confusum sp. nov.

Sori in the ovaries, enclosed by the enveloping glumes, elongated, tapering above, 3 mm. in length, provided with an inconspicuous membrane which ruptures irregularly: spore-balls irregular, subglobose or elongated, 30–100 μ in length, at first firm, but easily separating into spores: spores subspherical or polyhedral, frequently flattened and so appearing elongated or subcircular in section, according to view, mostly 12–14 μ, occasionally only 10 μ and reaching 15.5 μ in length; wall verruculose.

On Poaceae:

Aristida dichotoma Michx. Pennsylvania, *Trimble;* Ohio; Delaware, *Jackson.*

Aristida purpurascens Poir. (?) Alabama, *Underwood.*

TYPE LOCALITY: Newark, Delaware, on *Aristida dichotoma.*

DISTRIBUTION: Delaware to Ohio and Alabama.

EXSICCATI: Ellis & Ev. N. Am. Fungi *1494*.

The two species are easily separated by the character of the sorus. In *S. Ellisii* the whole infloresence is affected, in *S. confusum* only the ovaries. The spores in the latter are somewhat smaller than in the former.

The Delaware specimen is selected as the type because it is the best material we have seen. The specimens in Ellis & Ev. N. A. Fungi *1494* are mostly barren. This fact, together with

* Taken from Clinton, N. A. Flora 7: 39. 1906.

† See Saccardo, Sylloge Fungorum 13: 123; *Sorosporium Aristidae* Neg. (unpublished?).

the small number of collections made, probably accounts for this species having been so long overlooked. The type specimen has been deposited in the herbarium of the New York Botanical Garden. The Alabama material differs from the type in its slightly darker spores. The Ohio material has not been seen, but is here included on the authority of Clinton (*l. c.*).

The writer here acknowledges the kindness of the officials of the New York Botanical Garden in giving him unrestricted use of their library and herbarium.

AGRICULTURAL EXPERIMENT STATION,
NEWARK, DELAWARE.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1908)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions their kindness will be appreciated.

This Index is reprinted monthly on cards, and furnished in this form to subscribers, at the rate of one cent for each card. Selections of cards are not permitted; each subscriber must take all cards published during the term of his subscription. Correspondence relating to the card-issue should be addressed to the Treasurer of the Torrey Botanical Club.

Ames, O. *Orchidaceae*: illustrations and studies of the family *Orchidaceae*, issuing from the Ames Botanical Laboratory, North Easton, Massachusetts. Fascicle II. i–x. 1–288. *pl. 17–25*. 18 F 1908.

Arthur, J. C. New species of *Uredineae* — VI. Bull. Torrey Club **34**: 583–592. 27 F 1908.

Includes new species in *Puccinia* (7), *Prospodium*, *Calliospora*, *Aecidium* (3), *Caeoma*, and *Uredo* (2).

Barnhart, J. H. A new *Utricularia* from Long Island. Bull. Torrey Club **34**: 579–582. *pl. 34*. 27 F 1908.

Utricularia virgatula Barnhart.

Barnhart, J. H. The published work of Lucien Marcus Underwood. Bull. Torrey Club **35**: 17–38. 29 F 1908.

Basin, S. L. The plant and the season. Am. Homes and Gardens **5**: 116–119. [F] 1908.

Bicknell, E. P. The ferns and flowering plants of Nantucket — I. Bull. Torrey Club **35**: 49–62. 9 Mr 1908.

Bicknell, E. P. The white cedar in western Long Island. Torreya **8**: 27, 28. 26 F 1908.

Blumer, J. C. Some effects of frost in the Southwest. Torreya **8**: 25, 26. 26 F 1908.

Britton, E. G. Notes on nomenclature — IX. Bryologist **11**: 24, 25. Mr 1908.

Britton, E. G. The collections of mosses and hepatics. Jour. N. Y. Bot. Gard. **9**: 21–23. F 1908.

Britton, N. L. Professor Underwood's relation to the work of the New York Botanical Garden. Bull. Torrey Club **35**: 39, 40. 29 F 1908.

Britton, N. L. The herbarium of the late Dr. Otto Kuntze. Jour. N. Y. Bot. Gard. **9**: 19–21. F 1908.

Britton, N. L. & Rose, J. N. A preliminary treatment of the *Opuntioideae* of North America. Smithson. Misc. Coll. **50**: 503–540. 20 F 1908.

Includes 15 new species in *Opuntia.*

Chodat, R. Étude critique des genres *Scoparia* L. et *Hasslerella* Chod. (Suite et fin). Bull. Herb. Boiss. II. **8**: 85–89. *f. 27–36.* 31 Ja 1908.

Includes 2 new species, one each in *Scoparia* and *Hasslerella*, gen. nov.

Clarke, D. A. Flowering apples. Horticulture **10**: 293, 294. 7 Mr 1908. [Illust.]

Clute, W. N. A new fern from the United States. Fern Bull. **16**: 1, 2. [Mr] 1908. [Illust.]

Asplenium Ferrissi Clute.

Clute, W. N. But half a fern. Fern Bull. **16**: 5–12. [Mr] 1908. [Illust.]

Clute, W. N. Rare forms of ferns—VI. A cut-leaved crest fern. Fern Bull. **16**: 12, 13. [Mr] 1908. [Illust.]

Collins, F. S. George Edward Davenport. Rhodora **10**: 1–9. *portrait.* 20 F 1908.

Curtis, C. C. A biographical sketch of Lucien Marcus Underwood. Bull. Torrey Club **35**: 1–12. *portrait.* 29 F 1908.

Cushman, J. A. A synopsis of the New England species of *Tetmemorus.* Bull. Torrey Club **34**: 599–601. 27 F 1908.

Dode, L. A. Sur les platanes. Bull. Soc. Dendr. France **1908**: 27–68. 15 F 1908. [Illust.]

Edgerton, C. W. Notes on a parasitic *Gnomonia.* Bull. Torrey Club **34**: 593–597. *f. 1–3.* 27 F 1908.

Farlow, W. G. Notes on fungi — I. Rhodora **10**: 9–17. 20 F 1908.

Fernald, M. L. The representatives of *Rumex salicifolius* in eastern North America. Rhodora **10**: 17–20. 20 F 1908.

Fink, B. Further notes on Cladonias — XIV. *Cladonia digitata, Cladonia deformis,* and *Cladonia bellidiflora.* Bryologist **11**: 21–24. *pl. 3.* Mr 1908.

Foster, A. S. *Alnus oregana* as a cryptogamic host. Bryologist **11**: 33–35. Mr 1908.

Gandoger, M. Enumeratio *Atriplicum* in Argentina hucusque cognitarum. Bull. Soc. Bot. France **54**: 583–586. 7 Ja 1908.
Includes new species in *Atriplex* (2) and *Chenopodium*.

Grout, A. J. A list of mosses collected in the mountains of western North Carolina in the summer of 1907. Bryologist **11**: 25–30. Mr 1908.

Hammond, H. S. The embryology of *Oxalis corniculata*. Ohio Nat. **8**: 261–264. *pl. 18*. 15 F 1908.

Hans, A. *Polystichum acrostichoides* × *angulare*. Fern Bull. **16**: 14, 15. [Mr] 1908.

Hans, A. *Polystichum acrostichoides recurvatum*. Fern Bull. **16**: 15. [Mr] 1908.

Hemsley, W. B. The *Julianiaceae*: a new family of plants. Gard. Chron. **43**: 98, 99. *f. 42*. 15 F 1908.

Hill, E. J. A red-fruited huckleberry. Torreya **8**: 30, 31. 26 F 1908.

House, H. D. Two Bahamian species of *Evolvulus*. Bull. Torrey Club **35**: 89, 90. 9 Mr 1908.
Evolvulus bahamensis House and *E. Bracei* House, spp. nov.

Howe, M. A. Lucien Marcus Underwood: a memorial tribute. Bull. Torrey Club **35**: 13–16. 29 F 1908.

Howe, R. H. Lichens of the Mount Monadnock region, N. H. Bryologist **11**: 35–38. Mr 1908.

Jepson, W. L. The distribution of *Juglans californica* Wats. Bull. So. Cal. Acad. Sci. **7**: 23, 24. Ja 1908.

Klincksieck, P. Les plantes d'Europe adventices ou naturalisées aux États-Unis d'Amérique, constatées à deux intervalles: 1832 et 1896. Bull. Soc. Bot. France **54**: xxx–xlii. 7 Ja 1908.

Livingston, B. E. A method of controlling plant moisture. Plant World **11**: 39, 40. F 1908.

Lloyd, F. E. A perennial dodder. Plant World **11**: 40, 41. F 1908.

MacDougal, D. T. First crosses breeding true. Plant World **11**: 42. F 1908.

MacDougal, D. T. Heredity and environic forces. Science II. **27**: 121–128. 24 Ja 1908.

MacDougal, D. T. Problems of the desert. Plant World **11**: 28–39. *f. 1*. F 1908.

Mackenzie, K. K. Notes on *Carex* — III. Bull. Torrey Club **34**: 603–607. 27 F 1908.
Includes 4 new species.

Malme, G. O. A. Contributions à l' étude des espèces paraguayenses du genre *Oxypetalum* R. Br.—I. Section *Tweediopsis*. Bull. Herb. Boiss. II. **8**: 98–106. 31 Ja 1908.
Includes 5 new species.

Monks, S. P. Diatoms. Bull. So. Cal. Acad. Sci. **7**: 12–17. *f. 1–4*. Ja 1908.

Murrill, W. A. The spread of the chestnut disease. Jour. N. Y. Bot. Gard. **9**: 23–30. *f. 4–8*. F 1908.

Nestler, A. Das Sekret der Drüsenhaare der Gattung *Cypripedium* mit besonderer Berücksichtigung seiner hautreizenden Wirkung. Ber. Deuts. Bot. Gesells. **25**: 554–567. *pl. 14*. 27 Ja 1908.

Ortmann, A. E. The distribution of closely allied species. Science II. **27**: 427–429. 13 Mr 1908.

Osborne, T. B. & Clapp, S. H. Hydrolysis of the proteins of maize, *Zea Mays*. Am. Jour. Physiol. **20**: 477–493. 1 Ja 1908.

Osborne, T. B. & Clapp, S. H. The hydrolysis of gliadin from rye. Am. Jour. Physiol. **20**: 494–499. 1 Ja 1908.

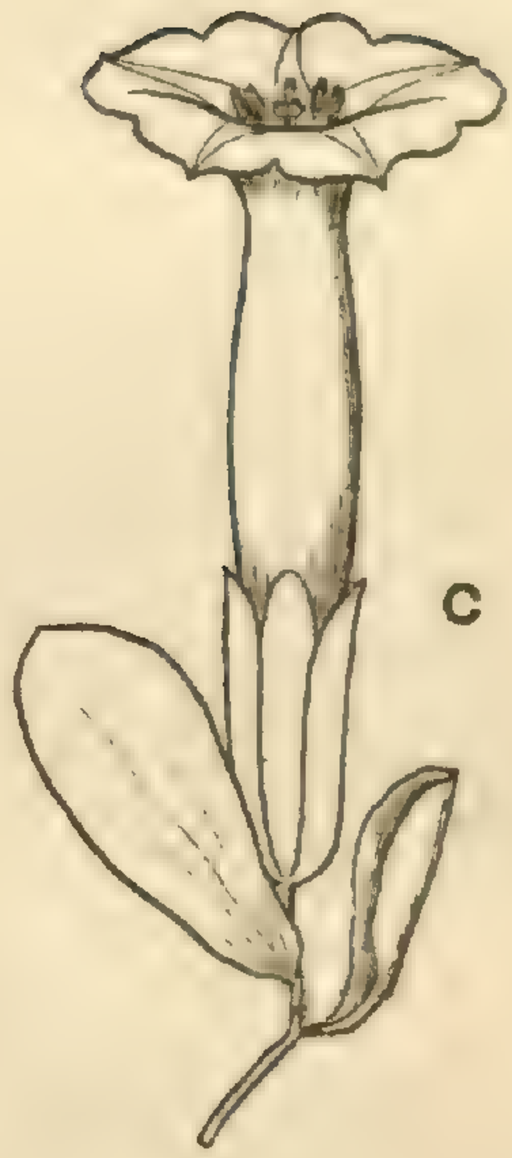
Pool, R. J. Some common shrubs [of the Trinchera estate, Colorado]. Arboriculture **7**: 35. Mr 1908.

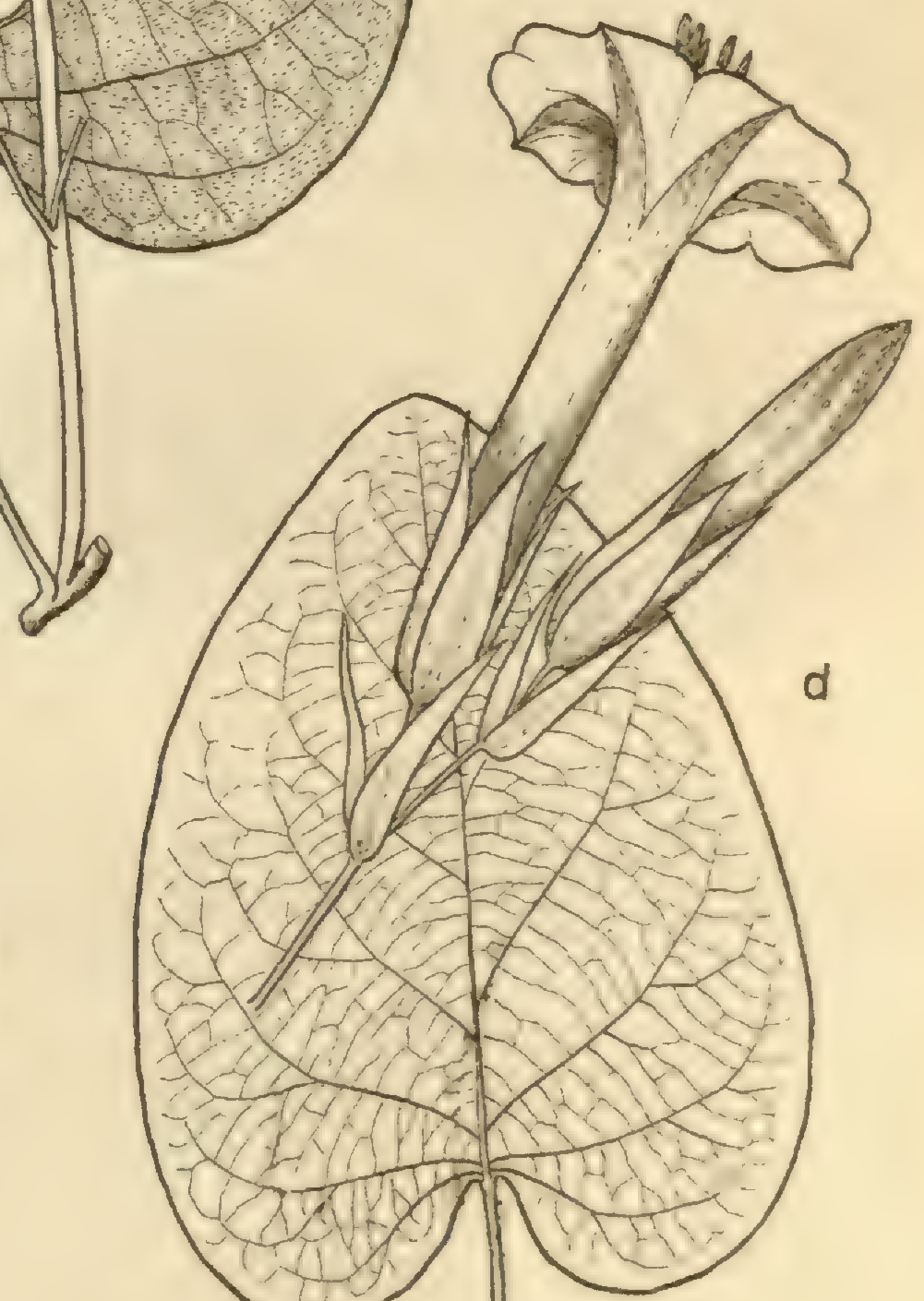
Reynolds, E. S. *Scirpus hudsonianus* in Rhode Island. Rhodora **10**: 20. 20 F 1908.

Robinson, C. B. Alabastra philippinensia — I. Bull. Torrey Club **35**: 63–75. 9 Mr 1908.

Robinson, C. B. The name *Chara*. Torreya **8**: 29, 30. 26 F 1908.

Roland-Gosselin, R. *Cereus tricostatus* sp. nov. et *Cereus Plumieri* sp. nov. Bull. Soc. Bot. France **54**: 664–669. 10 F 1908.
The species are from Mexico and the Grenadine Islands, respectively.



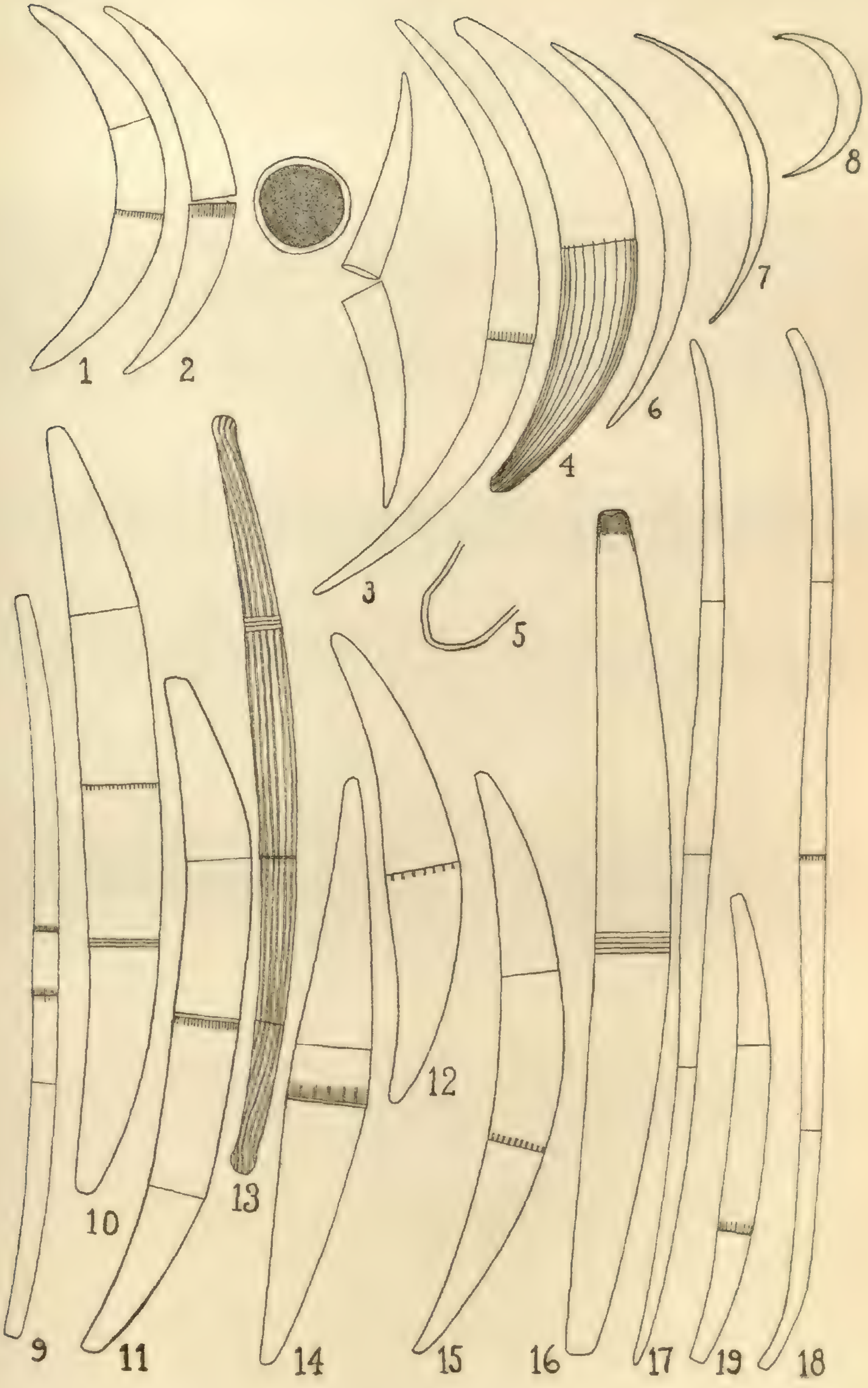


a. EXOGONIUM RUDOLPHII (Roem.& Schult) House
b. EXOGONIUM VELUTIFOLIUM House
c. EXOGONIUM RACEMOSUM (Poir.) Choisy
d. EXOGONIUM WRIGHTII House

COCKAYNE, BOSTON

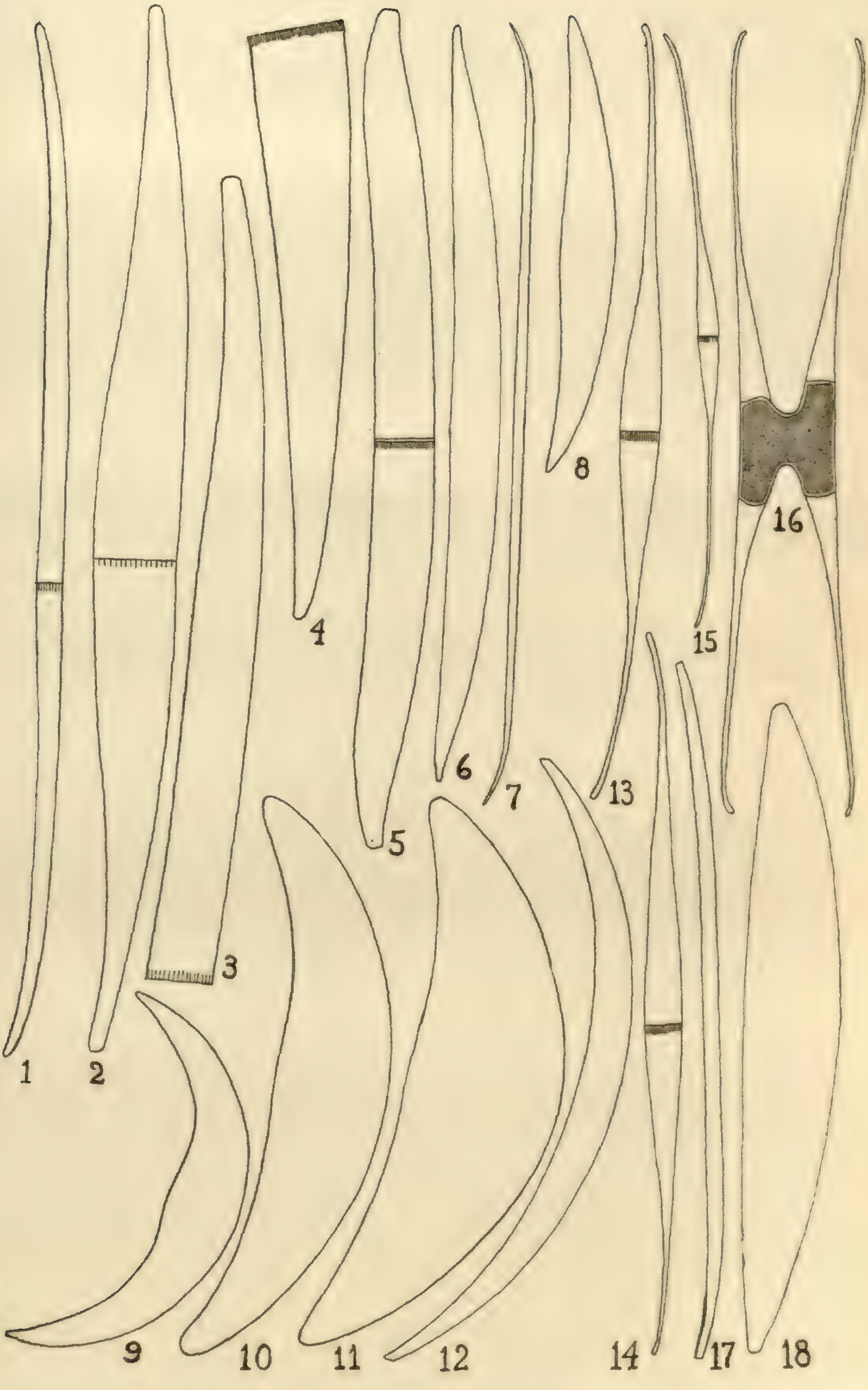
a. EXOGONIUM EGGERSII House
b. EXOGONIUM CUBENSE House
c. EXOGONIUM LUTEUM House
d. EXOGONIUM ARENARIUM Choisy

COCKAYNE, BOSTON



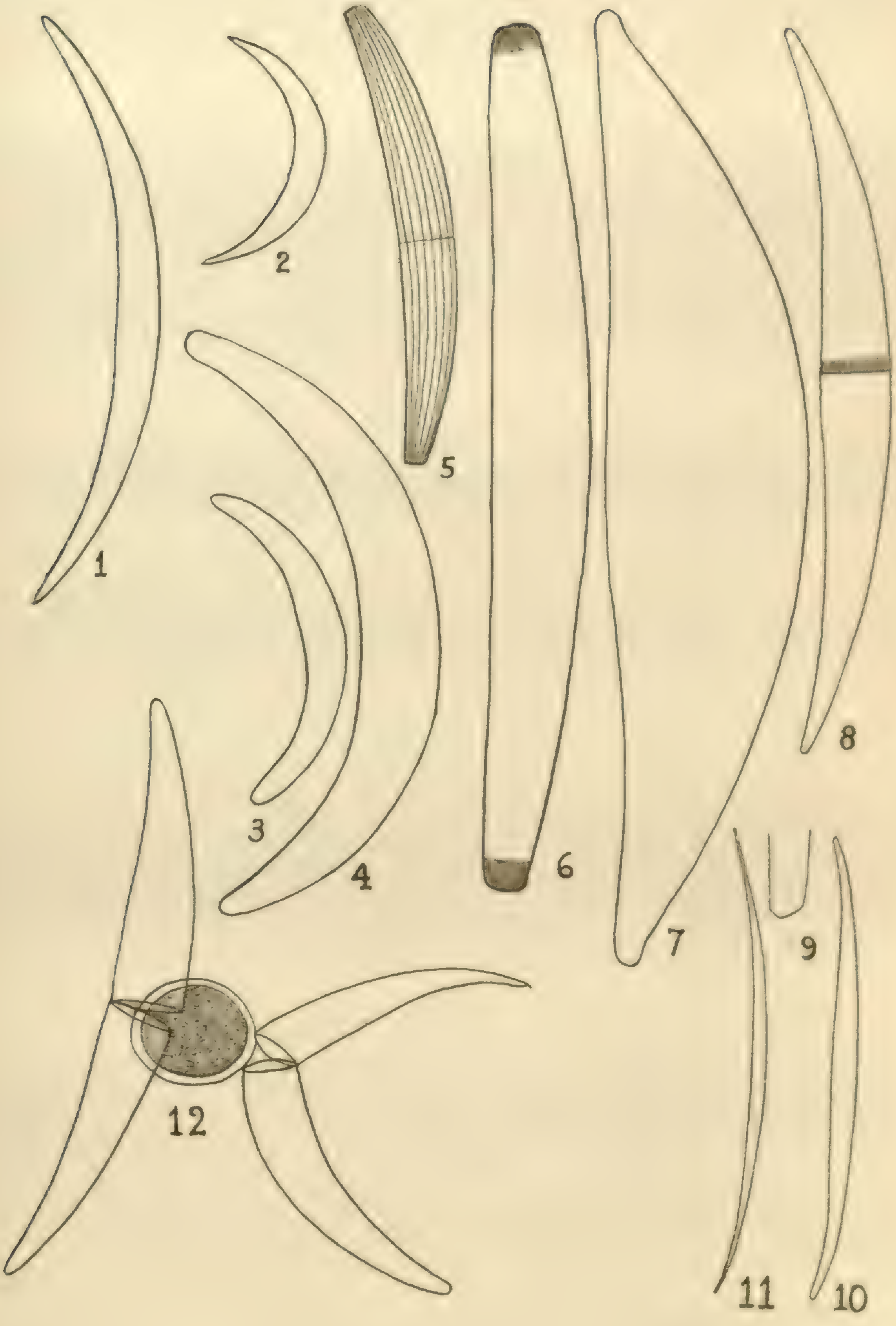
NEW ENGLAND SPECIES OF CLOSTERIUM

COCKAYNE, BOSTON



NEW ENGLAND SPECIES OF CLOSTERIUM

COCKAYNE, BOSTON



NEW ENGLAND SPECIES OF CLOSTERIUM

COCKAYNE, BOSTON

FOR SALE

A limited number of sets of Kansas plants (about 1100 numbers each) at $65.00 per set. Address

Department of Botany, Kansas State Agricultural College

MANHATTAN KANSAS

THE BRYOLOGIST

WITH THE JANUARY, 1908, NUMBER BEGINS ITS

ELEVENTH YEAR AND VOLUME

It is a 16–20 page bi-monthly devoted to the study of the Mosses, Hepatics, and Lichens. It is fully illustrated with new, original, and artistic drawings and half-tones. It is indispensable to the working bryologist, professional as well as amateur. Send for sample copy. Subscription price $1.00 a year.

Address, MRS. ANNIE MORRILL SMITH, 78 Orange Street, Brooklyn, N. Y.

INDEX TO AMERICAN BOTANICAL LITERATURE

This Index, printed each month in the BULLETIN, is reissued on library catalogue cards; these are furnished to subscribers at the rate of one cent for each card.

Subscriptions to the card-issue may be addressed to the Treasurer of the Torrey Botanical Club,

WILLIAM MANSFIELD, COLLEGE OF PHARMACY, 115 W. 68th St., N. Y. City.

Beginning with January, 1903, the Index has also been reprinted on paper, on one side only, and can be furnished in that form at the rate of $3.00 a year.

FOR SALE

Bound volumes: Bulletin of the Torrey Botanical Club, Vols. 12–26; Memoirs, Vols. 1–7. Botanical Gazette, Vols. 12–16. Thomé, Flora von Deutschland, Österreich, und der Schweiz; Müller, Die Befruchtung der Blumen. For particulars address

E. B. MILLER,

WOODLAND NEW JERSEY

North American Flora

THIS work is designed to present descriptions of all plants growing independent of cultivation, in North America, here taken to include Greenland, Central America, the Republic of Panama, and the West Indies, except Trinidad, Tobago, and Curaçao and other islands off the north coast of Venezuela, whose flora is essentially South American.

It will be published in parts at irregular intervals by the New York Botanical Garden through the aid of the income of the David Lydig Fund bequeathed by Charles P. Daly.

It is planned to issue parts as rapidly as they can be prepared, the extent of the work making it possible to commence publication at any number of points. The completed work will form a series of volumes with the following sequence:

Volume 1. Mycetozoa, Schizophyta, Diatomaceae.
Volumes 2 to 10. Fungi.
Volumes 11 to 13. Algae.
Volumes 14 and 15. Bryophyta.
Volume 16. Pteridophyta and Gymnospermae.
Volumes 17 to 19. Monocotyledones.
Volumes 20 to 30. Dicotyledones.

The preparation of the work has been referred by the Scientific Directors of the Garden to a committee consisting of Professors L. M. Underwood and N. L. Britton.

Professor George F. Atkinson of Cornell University, Professors Charles R. Barnes and John M. Coulter of the University of Chicago, Mr. Frederick V. Coville of the United States Department of Agriculture, Professor Edward L. Greene of the United States National Museum, Professor Byron D. Halsted of Rutgers College and Professor William Trelease of the Missouri Botanical Garden have consented to act as an advisory committee.

The subscription price is fixed at $1.50 for each part; it is expected that four or five parts will be required for each volume. A limited number of separate parts will be sold at $2.00 each. Address,

THE NEW YORK BOTANICAL GARDEN

BRONX PARK, NEW YORK CITY

Vol. 7, Part 1, Ustilaginales, including Ustilaginaceae and Tilletiaceae, by G. P. Clinton, was issued Oct. 4, 1906. Vol. 7, Part 2, Coleosporiaceae, Uredinaceae and Aecidiaceae (pars), of the Uredinales, by J. C. Arthur was issued March 6, 1907. Vol. 22, Part 1, including Podostemonaceae by George V. Nash, Crassulaceae by N. L. Britton and J. N. Rose, and Penthoraceae and Parnassiaceae by P. A. Rydberg, was issued May 22, 1905. Vol. 22, Part 2, including Saxifragaceae and Hydrangeaceae by J. K. Small and P. A. Rydberg, Cunoniaceae, Iteaceae, and Hamamelidaceae by N. L. Britton, Pterostemonaceae by J. K. Small, Altingiaceae by Percy Wilson and Phyllonomaceae by H. H. Rusby, was issued Dec. 18, 1905. Vol. 25, Part 1, including Geraniaceae, by L. T. Hanks and J. K. Small, Oxalidaceae and Linaceae by J. K. Small, and Erythroxylaceae by N. L. Britton, was issued Aug. 24, 1907. Vol. 9, Part 1, Polyporaceae (pars), by W. A. Murrill, was issued Dec. 19, 1907.

PUBLICATIONS BY OFFICERS AND STUDENTS OF THE DEPARTMENT OF BOTANY, COLUMBIA UNIVERSITY

1. MEMOIRS OF THE DEPARTMENT:

Vol. 1. A Monograph of the North American Species of the Genus *Polygonum* (1895). By John Kunkel Small, Fellow in Botany, 1893–1895; Curator of the Herbarium, 1895–1898.

Quarto, 178 pages, 84 plates. Price $6.00.

Vol. 2. A Monograph of the North American Potentilleae (1898). By Per Axel Rydberg, Fellow in Botany, 1896–7.

Quarto, 224 pages, 112 plates. Price $6.00.

2. CONTRIBUTIONS FROM THE DEPARTMENT:

Vol. 1. Nos. 1–25. 1886–1892. Price $5.00.
Vol. 2. Nos. 26–50. 1892–1894. Price $5.00.
Vol. 3. Nos. 51–75. 1894–1895. Price $5.00.
Vol. 4. Nos. 76–100. 1895–1896. Price $5.00.
Vol. 5. Nos. 101–125. 1896–1897. Price $5.00.
Vol. 6. Nos. 126–150. 1897–1898. Price $5.00.
Vol. 7. Nos. 151–175. 1898–1901. Price $5.00.
Vol. 8. Nos. 176–200. 1901–1902. Price $5.00.
Vol. 9. Nos. 201–. 1903–(current).

List of separate numbers available on application.

3. A Text-book of General Lichenology (1896). By Albert Schneider, Fellow in Botany, 1895–1896.

Octavo, 230 pages, 76 plates. Price $4.25 (cloth); $3.80 (paper). Published by Willard N. Clute & Co. Binghamton, N. Y.

The Department invites propositions relative to exchanges of herbarium material for any of the above named publications. Address Dr. Carlton C. Curtis, Columbia University, N. Y. City.

4. An Illustrated Flora of the Northern United States, Canada, and the British Possessions from Newfoundland to the Parallel of the Southern Boundary of Virginia, and from the Atlantic Ocean westward to the 102d Meridian (1896–1898). By Nathaniel Lord Britton, Professor of Botany, 1891–1896; Emeritus Professor 1896–, and Hon. Addison Brown.

Three volumes, royal octavo. Vol. 1, 612 pages; Vol. 2, 642 pages; Vol. 3, 588 pages; 4162 figures in the text, illustrating every species described.

Published by Charles Scribner's Sons, New York. Price, in cloth, $9.00 for the three volumes; with the indexes and keys bound separately, $10.00.

5. Our Native Ferns and their Allies. (Sixth Edition) 1900. By Lucien Marcus Underwood, Professor of Botany, 1896–1907.

Duodecimo, 158 pages, 35 figures. Published by Henry Holt & Co., New York. Price, $1.00.

6. Moulds, Mildews, and Mushrooms. By Lucien Marcus Underwood, Professor of Botany, 1896–1907.

Duodecimo, 236 pages, 10 plates. Published by Henry Holt & Co. Price $1.50.

7. Nature and Development of Plants (1907). By Carlton Clarence Curtis, Assistant in Botany, 1892–1895; Tutor in Botany, 1895–1906; Instructor in Botany, 1906–.

Octavo, 471 pages; 342 illustrations. Published by Henry Holt & Co., New York. Price $2.50.

ESTABLISHED 1851

EIMER & AMEND

205–211 Third Ave.,
Corner 18th Street

NEW YORK

MANUFACTURERS AND IMPORTERS OF

Chemicals and Chemical Apparatus

Our Specialties

MICROSCOPES
and
ACCESSORIES

MICROTOMES

BALANCES
and
WEIGHTS

Sole Agents for

C. A. F.
KAHLBAUM'S
C. P. Chemicals
and Reagents

CARL
SCHLEICHER
& SCHÜLL'S
C. P. Filters

SCHOTT &
GENOSSEN'S
Famous Laboratory Glassware

And for many other renowned European houses in our line.

COMPLETE LINE OF

Bacteriological Apparatus

WE HANDLE

EVERYTHING NEEDED FOR A LABORATORY

Inspection of premises cordially invited.

MEMOIRS OF THE TORREY BOTANICAL CLUB

A series of technical papers on botanical subjects, published at irregular intervals. Price $3.00 a volume. Not offered in exchange.

Vol. 1, No. 1; not furnished separately:

Bailey, Liberty Hyde. Studies of the types of various species of the genus *Carex*. Pages 1–85. 25 My 1889.

Vol. 1, No. 2; not furnished separately:

Martindale, Isaac Comly. Marine algae of the New Jersey coast and adjacen waters of Staten Island. Pages 87–111. 24 Au 1889.

Vol. 1, No. 3; price, 75 cents:

Spruce, Richard. *Hepaticae* Bolivianae, in Andibus Boliviae orientalis, annis 1885–6, a cl. H. H. Rusby lectae. Pages 113–140. 20 Ja 1890.

Vol. 1, No. 4; price, 75 cents:

Sturtevant, Edward Lewis. On seedless fruits. Pages 141–187. 30 My 1890.

Vol. 2, No. 1; not furnished separately:

Halsted, Byron David. Reserve food-materials in buds and surrounding parts. Pages 1–26, *plates 1, 2.* 10 S 1890.

Vol. 2, No. 2; price, 75 cents:

Vail, Anna Murray & Hollick, Charles Arthur. Contributions to the botany of Virginia. Pages 27–56, *plates 3, 4.* 23 D 1890.

Vol. 2, No. 3; not furnished separately:

Holm, Herman Theodor. Contributions to the knowledge of the germination of some North American plants. Pages 57–108, *plates 5–19.* 15 Ap 1891.

Vol. 2, No. 4; price, 75 cents:

Wheelock, William Efner. The genus *Polygala* in North America. Pages 109–152. 30 D 1891.

Vol. 3, No 1; not furnished separately:

Small, John Kunkel & Heller, Amos Arthur. Flora of western North Carolina and contiguous territory. Pages 1–39. 20 F 1892.

Vol 3, No. 2; price, $2.00:

Morong, Thomas. The *Naiadaceae* of North America [with illustrations of all the species]. Pages 1–65, *plates 20–74.* 15 Mr 1893.

Vol. 3, No. 3; not furnished separately:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. [Part 1.] Pages 1–67. 28 Ap 1893.

Vol. 4, No. 1; not furnished separately:

Underwood, Lucien Marcus. Index *Hepaticarum.* Part I, Bibliography. Pages 1–91. 10 Je 1893.

Vol. 4, No. 2; not furnished separately:

Small, John Kunkel & Vail, Anna Murray. Report on the botanical exploration of southwestern Virginia during the season of 1892. Pages 93–201, *plates 75–82.* 18 N 1893–17 Ap 1894.

Vol. 4, No. 3; price, 50 cents:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 2. Pages 203–274. 10 Mr–17 Ap 1895.

Vol. 4, No. 4; price, 50 cents:

Pettit, Anna Stockton. *Arachis hypogaea* L. Pages 275–296, *plates 83–85* 5 Je 1895.

Vol. 4, No. 5; price, 75 cents:

Rydberg, Per Axel. The North American species of *Physalis* and related genera. Pages 297–374. 15 S 1896.

Vol. 5; price, $3.00:

List of *Pteridophyta* and *Spermatophyta* growing without cultivation in northeastern North America. Pages 1–377. 4 D 1893–31 D 1894.

Vol. 6, No. 1; price, $1.25:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 3. Pages 1–130. 17 N 1896.

Vol. 6, No. 2; not furnished separately:

Grout, Abel Joel. A revision of the North American *Isotheciaceae* and *Brachythecia*. Pages 131–210. 30 Jl 1897.

Vol. 6, No. 3; price, 50 cents:

Hazen, Tracy Elliot. The life history of *Sphaerella lacustris* (*Haematococcus pluvialis*). Pages 211–246, *plates 86, 87* (*colored*). 8 Je 1899.

Vol. 6, No. 4; price, 50 cents:

Underwood, Lucien Marcus. A review of the genera of ferns proposed prior to 1832. Pages 247–283. 1 D 1899.

Vol. 6, No. 5; price, 25 cents:

Funk, Bruce. Notes on lichen distribution in the upper Mississippi Valley. Pages 285–307. 1 D 1899.

Vol. 7; price, $3.00:

Howe, Marshall Avery. The *Hepaticae* and *Anthocerotes* of California. Pages 1–208, *plates 88–122*. 5 Au 1899.

Vol. 8, No. 1; not furnished separately.

Lloyd, Francis Ernest. The comparative embryology of the *Rubiaceae*. Part I. Pages 1–26, *plates 1–4*. 26 Au 1899. Part II. Pages 27–112, *plates 5–15*. 15 F 1902.

Vol. 8, No. 2; price, $1.00:

Evans, Alexander William. The *Lejeuneae* of the United States and Canada. Pages 113–183, *plates 16–22*. 15 F 1902.

Vol. 8, No. 3; price, 75 cents:

Britton, Elizabeth Gertrude & Taylor, Alexandrina. The life history of *Vittaria lineata*. Pages 185–211, *plates 23–31*. 30 Au 1902.

Vol. 9; price, $3.00:

Salmon, Ernest Stanley. A monograph of the *Erysiphaceae*. Pages 1–292, *plates 1–9*. 4 O 1900.

Vol. 10; price, $3.00:

Burgess, Edward Sandford. History of Pre-Clusian botany in its relation to *Aster*. Pages i–xii, 1–447. 22 N 1902.

Vol. 11, No. 1; price, $1.75:

Griffiths, David. The North American *Sordariaceae*. Pages 1–134, *plates 1–19*. 30 My 1901.

Vol. 11, No. 2; price, $1.75:

Hazen, Tracy Elliot. The *Clothricaceae* and *Chaetophoraceae* of the United States. Pages 135–250, *plates 20–42*. 20 O 1902.

Vol. 12, No. 1; price, $1.50:

Northrop, Alice Rich. Flora of New Providence and Andros (Bahama Islands). Pages 1–98, *plates 1–19 + map*. 10 D 1902.

Vol. 12, No. 2; price, $1.00:

Banker, Howard James. A contribution to a revision of the North American *Hydnaceae*. Pages 99–194. 13 Je 1906.

Vol. 12, No. 3; price, 75 cents:

Kupfer, Elsie. Studies in Plant Regeneration. Pages 195–241. 10 Je 1907.

Vol. 13; price, $3.00:

Burgess, Edward Sandford. Species and variations of Biotian Asters, with discussion of variability in *Aster*. Pages i–xv, 1–419, *plates 1–13*. 15 Mr 1906.

Address: **TORREY BOTANICAL CLUB,**
Columbia University, New York City.

VOL. 35 APRIL, 1908 NO. 4

BULLETIN

OF THE

TORREY BOTANICAL CLUB

Editor

MARSHALL AVERY HOWE

Associate Editors

JOHN HENDLEY BARNHART
JEAN BROADHURST
PHILIP DOWELL
ALEXANDER WILLIAM EVANS
TRACY ELLIOT HAZEN
WILLIAM ALPHONSO MURRILL
CHARLES LOUIS POLLARD
HERBERT MAULE RICHARDS

CONTENTS

Hepaticae of Puerto Rico.—IX. Brachiolejeunea, Ptychocoleus, Archilejeunea, Leucolejeunea, and Anoplolejeunea. (Plates 6–8.)
ALEXANDER WILLIAM EVANS 155

The ferns and flowering plants of Nantucket — II. . EUGENE P. BICKNELL 181

The genus Ernodea Swartz: a study of species and races.
NATHANIEL LORD BRITTON 203

The development of the embryo-sac and embryo of Potamogeton lucens. (Plates 9 and 10) . . . . . MELVILLE THURSTON COOK 209

INDEX TO AMERICAN BOTANICAL LITERATURE. 219

PUBLISHED FOR THE CLUB

THE NEW ERA PRINTING COMPANY
LANCASTER, PA.

THE TORREY BOTANICAL CLUB

President,
HENRY H. RUSBY, M.D.

Vice-Presidents,
EDWARD S. BURGESS, PH.D. JOHN HENDLEY BARNHART, A.M., M.D.

Recording Secretary,
C. STUART GAGER, PH.D.
Botanical Garden, Bronx Park, New York City.

Treasurer,
WILLIAM MANSFIELD, PHAR.D.
College of Pharmacy,
115 West 68th St., New York City.

MEETINGS

Meetings twice each month from October to May inclusive: the second Tuesday, at 8:00 P.M., at the American Museum of Natural History; the last Wednesday, at 3:30 P.M., in the Museum Building of the New York Botanical Garden.

PUBLICATIONS

All subscriptions and other business communications relating to the publications of the Club should be addressed to the Treasurer, William Mansfield, College of Pharmacy, 115 West 68th St., New York City.

Bulletin. Monthly, established 1870. Price, $3.00 a year; single numbers 30 cents. Of former volumes, only 24–33 can be supplied separately; certain numbers of other volumes are available, but the entire stock of some numbers has been reserved for the completion of sets. Manuscripts intended for publication in the BULLETIN should be addressed to Marshall A. Howe, Editor, New York Botanical Garden, Bronx Park, New York City.

Torreya. Monthly, established 1901. Price, $1.00 a year. Manuscripts intended for publication in TORREYA should be addressed to Jean Broadhurst, Editor, Teachers College, Columbia University, New York City.

Memoirs. Occasional, established 1889. (See last pages of cover.)

Preliminary Catalogue of Anthophyta and Pteridophyta within 100 miles of New York City, 1888. Price, $1.00.

Vol. 35 No 4

BULLETIN

OF THE

TORREY BOTANICAL CLUB

APRIL, 1908

Hepaticae of Puerto Rico

IX. BRACHIOLEJEUNEA, PTYCHOCOLEUS, ARCHILEJEUNEA, LEUCOLEJEUNEA, AND ANOPLOLEJEUNEA

ALEXANDER WILLIAM EVANS

(WITH PLATES 6–8)

BRACHIOLEJEUNEA

The genus *Brachiolejeunea* includes between twenty and thirty recognized species. About half of these are American, the others being found in eastern Asia or among the islands of the Pacific. No species has as yet been reported from Africa. Although essentially tropical in its distribution, the genus reaches its northern limits in Florida and Japan and its southern in Australia and Patagonia. Since the first species described by Spruce is *B. laxifolia* (Tayl.) Schiffn., this may be considered the type of the genus. It was originally described from specimens collected by Jameson in Ecuador but is now known also from Bolivia.

With scarcely an exception the species of *Brachiolejeunea* are found on trees or on rotten logs. In many cases they grow mixed with other *Lejeuneae* or with *Frullaniae* but they sometimes form extensive mats by themselves. The plants are usually more or less pigmented and often appear very dark brown or nearly black, with little or no indication of glossiness. The prostrate stems cling closely to the substratum by means of numerous rhizoids, which take their origin from rudimentary discs at the bases of the underleaves. The branching is at first irregularly pinnate, but the female plants after flowering usually exhibit a false dichotomy very much as in *Marchesinia*.

The leaves are imbricated and sometimes densely so. In dry

[The BULLETIN for March, 1908 (35: 97–154, *pl. 1–5*), was issued 20 Ap 1908.]

plants the lobes are suberect and wrapped around the stem, but as soon as they become moistened they spread widely (PLATE 6, FIGURE 1) and assume a more or less squarrose position. The change in appearance is very similar to what is found in the genus *Mastigolejeunea*. The lobes are approximately ovate in outline and vary at the apex from rounded to apiculate or acute. The margin is usually entire, but, in certain species, tends to be slightly serrulate in the neighborhood of a female inflorescence. The lobule is relatively large and consists of two distinct portions approximately equal in size (FIGURES 1, 2). One of these occupies the carinal region and takes part in the formation of a conspicuous water-sac, usually about half as long as the lobe. The other is bounded by the free margin and is closely appressed to the lobe except at the apical sinus where an opening into the sac is to be observed. The appressed portion of the free margin bears a series of teeth from three to ten in number. These teeth vary greatly in size and in form (FIGURES 7–9), but in the majority of cases each tooth is several cells long and so strongly curved toward the lobe that it cannot be straightened out even by pressure on the cover-glass (FIGURE 12). The outermost tooth, which represents the apex of the lobule, varies from a single projecting cell to a broad and rounded projection (FIGURES 10, 11). The hyaline papilla is borne at the proximal base of this tooth but is displaced to the inner surface of the lobule, usually appearing two or three cells from the margin. Beyond the apical tooth the long and shallow sinus extends, forming a very acute angle with the outer part of the keel. The latter is more or less arched near the base but tends to be incurved where it meets the postical margin of the lobe. The leaf-cells have thin walls but distinct trigones (FIGURE 6). These are usually triangular in outline, two of the sides being convex and one concave. The thin places between the trigones are relatively wide and rarely develop intermediate thickenings.

The undivided underleaves are rotund to reniform in outline and are attached by an arched line (FIGURE 1). In certain species they are distinctly auriculate at the base (FIGURE 14); in others they are rounded or even cuneate. The margins are sometimes plane and sometimes more or less revolute; they vary from entire to irregularly sinuate but are never distinctly toothed.

In the majority of the species two types of branching are to be observed, very much as in the genus *Bryopteris* and in certain other genera of the *Lejeuneae Holostipae*.* In at least one species, however, all of the branches seem to conform to the *Lejeunea* type, being borne behind leaves with lobules. The *Frullania* type of branching, in which the subtending leaves fail to develop lobules, is largely restricted to robust vegetative axes. In a branch of this character the subtending leaf is partly inserted on the main axis and partly on the branch, the postical base being slightly revolute (FIGURES 2, 13). The first underleaf is usually distinctly bilobed and is displaced in such a way that the branch seems to arise from its axil. It embraces the base of the branch and partially enwraps the postical base of the subtending leaf. The first leaf is of small size and complicate-bilobed, but the lobule is explanate and rounded at the apex. The succeeding leaves and underleaves are normal in appearance. The *Lejeunea* type of branching, even where it does not occur in the vegetative portion of a plant, is almost invariably associated with subfloral innovations. An exception to this condition, however, is found in the remarkable *B. sandvicensis* (Gottsche) Evans, of eastern Asia and the Hawaiian Islands.† In this species the bract behind which a subfloral innovation arises is wholly destitute of a lobule and is partially inserted on the innovation itself.

The inflorescence in *Brachiolejeunea* seems to be fairly constant for a given species and may be dioicous, autoicous, or paroicous. The female branch varies greatly in length but is usually distinctly elongated. Subfloral innovations are invariably present and usually occur in pairs (FIGURES 4, 5); in rarer cases only one innovation is developed. The innovations are often floriferous and give rise to the false dichotomy which is characteristic of the genus. The bracts are scarcely complicate and the lobe is usually more pointed than in the leaves. In many species a wing is developed at the base of the keel (FIGURES 4, 5). The bracteole is free or nearly so and varies at the apex from rounded to retuse or shortly bilobed. The perianth scarcely projects beyond the bracts unless the basal portion elongates with the development of the sporophyte. It is

* See Evans, Bull. Torrey Club 34: 559. 1908.
† Trans. Conn. Acad. 10: 419. 1900.

approximately obovoid in shape and rounded to truncate at the apex, with a short beak. It is sometimes terete and sometimes more or less compressed, but even in the latter case the lateral keels are never sharp. The postical surface bears from two to five keels, and the antical surface is either plane or provided with three or four keels (FIGURES 21, 22). All of the keels are rounded and are never winged or toothed in any way. In pluriplicate perianths they are separated from one another by deep grooves, and there is no difference, except in position, between the lateral keels and the others.

In autoicous and dioicous species the male spikes are long and often proliferate at the apex. The bracts are imbricated and tend to be smaller than ordinary leaves, but their lobules are relatively larger and more strongly inflated. Even here the free margin of the lobule is usually more or less toothed. The antheridia occur in pairs, and the bracteoles are found throughout the entire length of the spike. In paroicous species the bracts are much fewer and are essentially like normal leaves; they differ also from the bracts just described in bearing the antheridia singly.

The present genus is in most respects clearly defined. The squarrose leaves, the large lobules with teeth along the free margin, the subfloral innovations usually occurring in pairs, and the plicate perianth with unarmed keels afford an excellent combination of generic characters. Certain species, however, as Spruce has already pointed out, show a relationship with *Marchesinia*, while others are even more closely allied to the genus *Ptychocoleus* as restricted in the present paper. In most species of *Marchesinia* the free margin of the lobule is also denticulate and the subfloral innovations occur in pairs, but the leaves are not squarrose and their lobes are relatively smaller and very different in appearance from those found in *Brachiolejeunea*. The perianth, moreover, is distinctly compressed and plane on both antical and postical surfaces. The characters which separate *Brachiolejeunea* from *Ptychocoleus* will be considered under the latter genus.

Two species of *Brachiolejeunea*, **B. densifolia** (Raddi) comb. nov.* and *B. corticalis* (Lehm. & Lindenb.) Schiffn., have been re-

*This species is commonly known as *B. bicolor* (Nees) Schiffn., in spite of the fact that *Frullanoides densifolia* Raddi and *Jungermannia bicolor* Nees have long been considered synonyms. Trevisan restored Raddi's specific name, but has not been fol-

ported from the West Indies. Neither of these has yet been found in Puerto Rico, but a third species occurs in recent collections from the island. It is apparently undescribed and may be characterized as follows:

Brachiolejeunea insularis sp. nov.

Dull-yellowish or brownish-green, sometimes almost black, scattered or growing in depressed mats: stems 0.25 mm. in diameter, sparingly pinnate, the branches obliquely to widely spreading, similar to the stem but with somewhat smaller leaves, never microphyllous: leaves closely imbricated, the lobes slightly falcate, ovate, 1.2–1.7 mm. long, 0.85–1.2 mm. wide, rounded to subcordate at the base and rounded or very obtuse at the apex, margin entire, strongly outwardly curved from the antical base to the apex; lobule ovate-triangular in outline, 0.85–1 mm. long, 0.35–0.45 mm. wide, the inflated portion forming a conical water-sac about half as long as the lobe, keel nearly straight from a more or less arched base, usually forming a continuous line with the postical margin of lobe, free margin rounded to cordate at the base, usually bearing from eight to ten more or less distinct teeth, those normally developed two or three cells long, one or two cells wide at the base and curved inward toward the lobe, apical tooth very variable; cells of lobe more or less convex, averaging 14 μ at the margin, 28 × 22 μ in the middle and 35 × 28 μ at the base, intermediate thickenings infrequent, oval: underleaves loosely imbricated, plane, broadly orbicular, 0.6–0.7 mm. long, 0.75–0.85 mm. wide, distinctly auriculate at the base with crenulate auricles, margin otherwise entire or irregularly sinuate, apex broad, truncate to retuse: inflorescence paroicous: ♀ inflorescence borne on a long branch and innovating on both sides; bracts erect-spreading, indistinctly complicate and unequally bifid, the lobe ovate to oblong, 1.4 mm. long, 0.85 mm. wide, rounded to obtusely pointed at the apex, margin more or less sinuate and crispate but not toothed, lobule adnate to lobe for greater part of its length, ovate to oblong, 0.85 mm. long, 0.35 mm. wide, apex mostly acute, rarely blunt, margin mostly entire but rarely with a tooth near the apex, wing broad, approximately semicircular, entire, usually adnate for its whole length; bracteole

---

lowed by subsequent authors. The synonymy of the species is as follows: *Frullanoides densifolia* Raddi, Mem. Soc. Ital. Modena Fis. 19: 38. 1823; 20: *pl. 2. f. 5.* 1829. *Jungermannia bicolor* Nees, in Martius, Fl. Bras. 1^1: 349. 1833. *Lejeunea bicolor* Nees, in Montagne, Flor. Boliv. 66; d'Orbigny, Voy. dans l'Amér. Merid. 7^2. 1839. *Phragmicoma bicolor* Nees, in G. L. & N. Syn. Hep. 294. 1845. *Ptychocoleus densifolius* Trevis. Mem. Ist. Lomb. III. 4: 405. 1877. *Lejeunea* (*Brachiolejeunea*) *bicolor* Spruce, Hep. Amaz. et. And. 131. 1884. *Brachiolejeunea bicolor* Schiffn. in Engler & Prantl, Nat. Pflanzenfam. 1^3: 128. 1895.

oblong to obovate, 1.2 mm. long, 0.85 mm. wide, plane or nearly so, margin entire or irregularly sinuate, apex broad, truncate or subretuse ; perianth slightly exserted beyond the bracts, oblong-obovoid, 1.5 mm. long, 0.85 mm. wide, rounded to truncate at the apex, slightly or not at all compressed, mostly ten-keeled, the keels extending to below the middle, rounded and separated by deep grooves : ♂ bracts in one or two pairs below the involucre, essentially like the ordinary leaves : mature sporophyte not seen. (PLATE 6.)

On trees and logs. Near Mayagüez, *Heller* (*4463a*). Near Cayey, *Evans* (*97*). Mount Morales, Utuado, *Howe* (*465*). The writer's specimens from near Cayey may be designated the type. The species has also been collected in Cuba, *Wright*, *Underwood & Earle*, and in Jamaica, *Underwood*, *Evans*.

B. insularis is closely related to *B. densifolia*, and the two species have been more or less confused. *B. densifolia* was originally collected in Brazil, where it seems to be abundant and widely distributed. Its range extends also along the chain of the Andes from Colombia to Bolivia. In North America it has been recorded from Mexico by Gottsche and from the island of St. Vincent by Spruce. It resembles *B. insularis* in general habit, in its auriculate underleaves and in its pluriplicate perianth. It is markedly distinct, however, in its dioicous inflorescence, the male inflorescences forming long spikes with closely crowded bracts. It differs also in its greater size, in its more sharply pointed leaves, in the fewer and smaller teeth along the free margin of the lobule and in its revolute underleaves. Even in *B. densifolia* the leaves are sometimes rounded as in *B. insularis*, but this is an exceptional condition and is usually associated with incomplete development.

B. corticalis, which is surely to be expected in Puerto Rico, is considerably smaller than *B. insularis*, and the teeth along the free margins of the lobules are fewer and simpler, each tooth consisting usually of a single projecting cell. The species is further characterized by its dioicous inflorescence, by the more distinct bracteal lobules, ligulate-lanceolate in outline and rounded at the apex, and by the more strongly compressed perianth with fewer and more irregular keels. Another close ally is *B. chinantlana* (Gottsche) Schiffn.,* at present known from Mexico and Ecuador.

* Hedwigia 33 : 180. *fl. 9. f. 32–40.* 1894. The species is based on *Phragmicoma bicolor* var. *chinantlana* Gottsche, Mex. Leverm. 172. 1863.

This species agrees with *B. insularis* in its inflorescence, but the lobes of its leaves and bracts are sharply pointed. The bracteole is also said to be emarginate or even bifid, but the figure of Schiffner does not show this condition clearly.

PTYCHOCOLEUS

The history of Trevisan's genus *Ptychocoleus* has already been noted by the writer in another connection.* It is based on *Phragmicoma*, § *Ptychanthoides* of the Synopsis Hepaticarum, and most of its species would be included in the genera *Acrolejeunea*, *Brachiolejeunea* or *Mastigolejeunea*, as these are at present understood. The first species listed by Trevisan is *P. aulacophorus* (Mont.) Trevis. This was originally described by Montagne,† under the name *Phragmicoma aulacophora*, from specimens collected in the Mangareva or Gambier Islands, of Spencer Gulf, South Australia, but is now known to have a wide range extending into both Asia and Africa. *Ptychocoleus aulacophorus* would naturally be selected as the type of the genus. This species, however, is placed by Stephani in *Acrolejeunea*, and it therefore seems justifiable, in restoring the name *Ptychocoleus*, to apply it to the genus *Acrolejeunea* as defined by Spruce and by Schiffner.

In this restricted sense *Ptychocoleus* would include between forty and fifty recognized species, all of which are tropical in their distribution. It attains its best development in southeastern Asia and the islands of the Pacific but is also well represented in Africa. In America five species are at present known, three of which have been reported from the West Indies. Only one species, however, *P. polycarpus* (Nees) Trevis., has been collected in Puerto Rico. As in the preceding genus, practically all the species of *Ptychocoleus* grow on trees or on rotten logs.

The genus is characterized by an elongated female branch without innovations and by a plicate perianth with smooth keels (PLATE 7, FIGURE 2), the number varying from four to ten in different species. The absence of subfloral innovations will at once distinguish it from *Brachiolejeunea*, but the two genera agree so

* Bull. Torrey Club 34 : 543. 1908.

† Ann. Sci. Nat. Bot. II. 19 : 259. 1843. Voy. au Pôle Sud, Bot. 1 : 210. *pl. 19. f. 1.* 1845.

closely in the characters derived from the lobes of the leaves, from the underleaves, and from the bracts and perianths that it would be superfluous to describe these organs in detail for *Ptychocoleus.* There are also no essential differences in color, in general habit, or in cell-structure. The lobules of the leaves, however, are much more variable in *Ptychocoleus* than in *Brachiolejeunea*, especially with respect to the number of teeth on the free margin. Certain species develop as many as four or five teeth, others only two (FIGURE 5), while in still others the margin is quite entire except for the apical tooth. In the position of the hyaline papilla the genus agrees with *Brachiolejeunea*, except for the fact that it is sometimes so much displaced that it is difficult to determine whether it is distal or proximal to the apical tooth, while on the other hand it may arise directly from a marginal cell. The position, however, is usually constant for a given species. The branching, so far as observed, always conforms to the *Lejeunea* type.

The genus shows but little relationship with other *Lejeuneae* which lack subfloral innovations. In *Lopholejeunea* the keels of the perianth are winged and variously toothed or laciniate, the lobules are built up on a different plan, and the local thickenings in the cell-walls are different. In *Caudalejeunea* the perianth is trigonous, its keels are normally winged and toothed, the plants are different in habit, and the leaf-cells show very numerous intermediate thickenings. In *Bryopteris* the female branch is much shorter, the perianth is again trigonous, the leaves and underleaves are sharply toothed, and the whole habit, general appearance, and cell-structure are different.

PTYCHOCOLEUS POLYCARPUS (Nees) Trevis.

Jungermannia polycarpa Nees, in Martius, Fl. Bras. **1**[1]: 350. 1833.

Phragmicoma polycarpa Nees, in G. L. & N. Syn. Hep. 295. 1845.

Lejeunea domingensis Tayl. Lond. Jour. Bot. **5**: 389. 1846.

Ptychocoleus polycarpus Trevis. Mem. Ist. Lomb. III. **4**: 405. 1877.

Lejeunea (*Acro-Lejeunea*) *domingensis* and *polycarpa* Spruce, Hep. Amaz. et And. 116. 1884.

Acrolejeunea polycarpa Schiffn. in Engler & Prantl, Nat. Pflanzenfam. **1**[3]: 128. 1895.

Olive-green, not glossy, scattered or growing in depressed mats: stems 0.17 mm. in diameter, irregularly pinnate, the branches widely spreading, occasionally microphyllous: leaves densely imbricated, the lobe suberect and convolute when dry, widely spreading and squarrose when moist, more or less convex, broadly ovate, slightly falcate, 1–1.2 mm. long, 0.85–0.95 mm. wide, arching partially or wholly across axis, rounded at base, rounded to very obtuse at the apex, margin entire, strongly outwardly curved from the antical base to the apex; lobule ovate, 0.6 mm. long, 0.35 mm. wide, the inflated portion occupying a little more than the carinal half, keel arched, forming an obtuse or rounded angle with the postical margin of lobe, free margin straight or a little curved, often bearing a tooth one or two cells long in the vicinity of the apical tooth, the latter mostly two cells long and one and two cells wide at the base, slightly outwardly curved, hyaline papilla borne on a marginal cell but slightly displaced to the inner surface of the lobule; cells of lobe plane or nearly so, averaging 15 μ at the margin, 23 × 18 μ in the middle and 35 × 18 μ at the base, intermediate thickenings occasional, oval or circular: underleaves loosely imbricated, plane or slightly revolute at the apex, broadly orbicular-obovate, 0.6 mm. long, 0.75 mm. wide, cuneate toward base and attached by an arched line, broad and truncate at the apex, margin entire or vaguely angular-denticulate: inflorescence autoicous or polyoicous: ♀ inflorescence borne on an ascending and more or less elongated branch; bracts widely spreading, complicate with a rounded keel and shortly and unequally bifid, the lobe ovate, 1.6 mm long, 0.85 mm. wide, acute and apiculate, the apex usually tipped with a row of two or three cells, margin entire, lobule acuminate, otherwise similar to the lobe, 1.4 mm. long, 0.4 mm. wide; bracteole free, oblong or ovate, 1.4 mm. long, 0.85 mm. wide, undivided and acute or shortly bidentate at the apex with sharp or blunt teeth, margin otherwise entire; perianth about one third exserted, obovoid, 1.5 mm. long, 0.85 mm. wide, slightly compressed and cuneate toward the base, truncate to retuse at the apex, antical face plane or nearly so, postical face with two confluent rounded keels often extending beyond the beak: ♂ inflorescence terminating a more or less elongated simple branch, not proliferating; bracts mostly in eight to twelve pairs, shortly and unequally bifid with a strongly arched keel, lobe obliquely spreading, more or less squarrose, rounded, lobule suberect, mostly acute; antheridia borne singly; bracteoles extending the whole length of the spike, similar to the underleaves but more often revolute at the apex: capsule about 0.5 mm. in diameter, walls of inner layer of cells thickened on the inside with a few large circular or oval pits;

spores green, spherical or ellipsoidal, 35 μ in diameter, minutely verruculose and with circles of indistinct radiating ridges; elaters about 10 μ in diameter, sometimes bispiral in the middle. (PLATE 7, FIGURES 1–11.)

On trees. Between Cayey and Caguas, *Howe* (*1411 p. p.*, *1414*). Type locality, Brazil, *Martius;* since found by numerous collectors. Known also from Mexico, *Liebman*, and from the following islands of the West Indies: Cuba, *Wright;* Santo Domingo, *Persoon* (the type locality of *Lejeunea domingensis*); Jamaica, *Harris*, *Evans*.

The species is not well described in the Synopsis Hepaticarum, but some of its most significant characters have since been emphasized by Schiffner.* Considerable confusion was introduced by Taylor into the synonymy of the plant by the publication of *Lejeunea domingensis*. This species was based on specimens which he at first called *L. linguaefolia*, and material thus named was deposited in the Hooker herbarium. Subsequently he renamed the species *L. domingensis* and transferred the name *L. linguaefolia* to an entirely distinct plant collected by Richard on the island of St. Thomas. Both species were soon afterwards published in the same paper. Many years later, Spruce, basing his opinion on the specimens in the Hooker herbarium rather than on Taylor's descriptions, referred both *L. domingensis* and *L. linguaefolia* to his subgenus *Acro-Lejeunea*, apparently considering them distinct from each other and also from *Ptychocoleus polycarpus*. Through the study of authentic material in the Lindenberg herbarium, Stephani † was able to reduce both species to synonymy, *L. domingensis* proving to be identical with *Ptychocoleus polycarpus* and the true *L. linguaefolia* from St. Thomas proving to be the same as *Brachiolejeunea corticalis*. Specimens in the Mitten herbarium, now in the possession of the New York Botanical Garden, amply confirm the conclusions of Stephani.

The keels of the perianth in *P. polycarpus* scarcely extend below the middle and are exceedingly variable even on a single plant. According to Schiffner, five or six keels are present, while Spruce gives the number as four or five. These discrepancies are

*Hedwigia 33: 181. 1894. See also Gottsche, Abhandl. naturw. Verein. Bremen 7: 350, 351. 1882.

†Hedwigia 28: 166, 167. 1889; 29: 22. 1890.

doubtless due to differences of interpretation. When the antical surface is deeply grooved it produces the effect of two rounded keels, making the total number five or six, according to whether the confluent postical keels are counted as one or two. When the antical face is plane the number of keels would naturally be estimated as four.

The two other species of *Ptychocolcus* which have been reported from the West Indies are *P. torulosus* (Lehm. & Lindenb.) Trevis. and *Lejeunea* (*Acrolejeunea*) *atroviridis* Spruce,* both of which are listed by Spruce from the island of St. Vincent, where they were collected by Elliott. The second of these species is known from no other locality, but *P. torulosus* is known also from Guiana and Brazil. In *L. atroviridis* the trigones of the leaves are absent or minute and the keels of the perianth are more or less roughened, so that it is possible that it ought to be referred to some other genus. *P. torulosus*, however, is a typical representative of *Ptychocoleus*. It may be at once distinguished from *P. polycarpus* by the blunt lobes and lobules of its bracts, by its truncate bracteole and by its seven- to nine-keeled perianth. It is distinct also in the lobules of its leaves, which bear from three to eight teeth along the free margin instead of one or two.

ARCHILEJEUNEA

According to Schiffner, the genus *Archilejeunea* contained thirty species in 1895, and perhaps a dozen new species have been proposed since he made his estimate. If, however, *A. porelloides* (Spruce) Schiffn., the first species described by Spruce, be selected as the type of the genus, certain species have been referred to it which can hardly be considered congeneric with this type species. This is the case, for example, with *A. pseudocucullata* Steph. (*Lejeunea holostipa* Spruce), which the writer has already made the type of the genus *Cyrtolejeunea*.† It is true of *A. xanthocarpa* (Lehm. & Lindenb.) Steph. and its immediate allies, for the reception of which the genus *Leucolejeunea* Evans has recently been proposed. It is also true of *A. conferta* (Meissn.) Schiffn., which belongs to the genus *Anoplolejeunea* and is even synonymous with its type species.

* Jour. Linn. Soc. Bot. 30: 335. *pl. 20. f. 5–10.* 1894.

† Bull. Torrey Club 30: 552. 1903.

If these aberrant forms are removed, the species which are left will fully agree with the characters assigned to the genus by Spruce and by Schiffner. In the majority of cases the plants are robust and show a reddish or brownish pigmentation. A prostrate and irregularly branched caudex is first developed, which clings closely to the substratum (PLATE 8, FIGURE 2). From this, secondary stems soon arise which are more or less free from the substratum and rarely form rhizoids; they branch irregularly, many of the branches being subfloral innovations (FIGURE 1). Although the branches frequently bear smaller leaves than the stem, they are never truly microphyllous.

The leaves are imbricated but not densely so, and the lobes spread obliquely or widely from the axis, being more or less falcate. They vary in outline from suborbicular to ligulate, the apices are rounded and the margins are entire. The lobules, in their most typical form, are rhomboidal in outline, the keel being straight or nearly so. In some cases about half of the lobule is appressed to the lobe, restricting the water-sac to a narrow linear space along the keel. In other cases the appressed portion is much narrower (FIGURE 2) and may even be absent altogether, the free margin meeting the lobe at a right angle. Under these circumstances the water-sac is relatively larger and the entire lobule may enter into its formation. The free margin is more or less curved and terminates in an apical tooth, which varies from subacute to long-acuminate; the sinus beyond is long but usually shallow. The hyaline papilla is at the proximal base of the apical tooth and may be either marginal or slightly displaced to the inner surface of the lobule. Except for the apical tooth the margin is commonly entire. In certain species, however, a second tooth is sometimes developed, proximal in position to the papilla (FIGURE 4). In some cases the secondary stems fail to develop normal lobules (FIGURE 1), and it becomes necessary to search for them on the prostrate caudex. The cells of the lobe have firm and pigmented walls and are usually a little convex. The trigones are large and conspicuous, and intermediate thickenings are frequent. The trigones are sometimes triangular but it is more usual for them to be triradiate with rounded rays (FIGURE 3).

The underleaves vary from orbicular to reniform. They are

broad and rounded at the apex, entire along the margin, and variable at the base, being sometimes cuneate and sometimes rounded or subcordate. The line of insertion is slightly arched and there is sometimes a rudimentary radicelliferous disc at the base. Except on the caudex, however, rhizoids are very scantily developed.

In the majority of cases the inflorescence is dioicous, but a few autoicous species have been described. The female inflorescence is borne on a secondary stem or one of its leading branches and usually innovates on only one side. In a few species, however, two subfloral innovations are occasionally developed. An innovation spreads obliquely and frequently forms a second archegonium after bearing only one or two pairs of foliage leaves. When this procedure is repeated several times in succession, a cymose flower-cluster is the result, in which the flowers seem to be borne along the upper side of a floral axis. In rare cases an innovation is terminated by an antheridial spike. The bracts are unequally bifid and sharply complicate but are apparently never winged along the keel. The lobes spread obliquely and are relatively narrower than in the leaves, often showing a tendency to be sharp-pointed at the apex. The lobule is also narrow and varies at the apex from rounded to acute. The bracteole is free and ovate to obovate in outline, the apex showing all variations in different species from rounded or retuse to bidentate or bifid. In both bracts and bracteoles the margins are commonly entire. The perianth is oblong to obovate in outline, with a rounded or truncate apex and a short beak. It is more or less compressed with sharp lateral keels (FIGURE 8). The antical surface commonly bears a short and low keel in the upper part, while the postical surface bears two sharp and confluent keels extending to below the middle. Both lateral and postical keels usually develop narrow and interrupted wings which are either irregularly sinuous or angular-dentate along the margin. In other respects the surface of the perianth is smooth.

The male inflorescence is large and conspicuous, terminating a secondary stem or one of its leading branches; in many cases, however, it proliferates at the apex. The diandrous bracts are loosely imbricated and unequally bifid, both lobe and lobule being either

rounded or very obtuse at the apex. The bracteoles extend the whole length of the spike and are much like the underleaves.

Several genera of the *Lejeuneae Holostipae* are more or less closely allied to *Archilejeunea*. Certain species of *Brachiolejeunea* and *Ptychocoleus*, for example, develop a five-keeled perianth which is built up on a very similar plan. In *Brachiolejeunea*, however, the lobule is differently constructed and shows a larger number of marginal teeth, while in *Ptychocoleus* no subfloral innovations are present. Both of these genera, moreover, are composed of prostrate species which show no distinction between caudex and secondary stems, and which are further characterized by the smooth and wingless keels of their perianths. In *Mastigolejeunea* the distinction between caudex and secondary stems is well marked but the perianth is sharply trigonous with smooth keels. Spruce divided his subgenus *Archi-Lejeunea* into two sections: *Monotropella*, in which the keels of the perianth are rough and the subfloral innovations usually occur singly; and *Dibrachiella*, in which the keels are smooth and the innovations are sometimes borne in pairs. Schiffner accepts both of these sections, making them subgenera of his genus *Archilejeunea*. Whether the slight differences just noted will ever be deemed sufficient to separate the groups generically is doubtful, since they share so many characters in common. It must be admitted, however, that *Dibrachiella* shows an especially close relationship to *Brachiolejeunea* and *Ptychocoleus*.

In its restricted sense *Archilejeunea* is almost exclusively tropical in its distribution. A number of species have been described from Africa and from the islands of the Pacific, but the highest development of the genus is attained in South America, where about half of the known representatives have been collected. At the present time no species are definitely known from Asia and only two species, both belonging to the subgenus *Dibrachiella*, have been reported from the West Indies. One of these is *A. Auberiana* (Mont.) Steph., originally described from Cuba, and the other is *A. Cruegeri* (Lindenb.) Schiffn., originally described from Trinidad. The distribution of these two species beyond the islands where they were first discovered is still imperfectly known. Stephani, to be sure, has reported *A. Auberiana* from Paramaribo

and Para,* and Spruce has also reported *A. Cruegeri* from the latter locality.† Stephani's report is based on two specimens in the Lindenberg herbarium, one doubtfully referred to *Lejeunea unciloba* Lindenb. and the other representing a portion of the original material of *L. cyclostipa* Tayl. The writer has examined both of these specimens and would refer the first to *L.* (*Archi-Lejeunea*) *florentissima* Spruce rather than to *A. Auberiana*;‡ the second is unfortunately so fragmentary that positive determination is hardly possible. With regard to *A. Cruegeri* the type material itself is scanty and poorly developed, making it difficult to obtain an adequate idea of the species. In view of these facts confirmatory evidence as to the occurrence of *A. Auberiana* and *A. Cruegeri* in South America is much to be desired. Although *Archilejeunea* has not yet been reported from Puerto Rico, a single species, also belonging to the subgenus *Dibrachiella*, has been found on the island, namely:

Archilejeunea viridissima (Lindenb.)

Lejeunea viridissima Lindenb. in G. L. & N. Syn. Hep. 320. 1845.

Lejeunea (*Archi-Lejeunea*) *viridissima* Steph. Hedwigia **29**: 17. 1890.

Yellowish- or brownish-green, becoming darker with age, neither glossy nor glaucous, growing in depressed mats: caudex and secondary stems about 0.14 mm. in diameter, the latter simple or sparingly subdivided, often with poorly developed lobules: leaves imbricated, the lobe widely spreading, slightly falcate, broadly ovate, 0.75 mm. long, 0.6 mm. wide, convex, and sometimes revolute at the broad and rounded apex and along the postical margin, antical margin straight or a little rounded at the base, then strongly outwardly curved to the apex; lobule (when well developed) ovate, 0.35 mm. long, 0.25 mm. wide, the water-sac broad at the base and abruptly narrowed in the outer part, free margin sometimes revolute at the base, sometimes appressed to the lobe from base to apex, rounded, normally bearing two teeth in the outer part, the outer or apical a little longer than the other and often variously curved, the inner varying from acute to obtuse and sometimes

* Hedwigia **29**: 15, 21. 1890.
† Hep. Amaz. et And. 97. 1884.
‡ See Torreya **7**: 228. 1908.

absent altogether, papilla marginal at base of apical tooth, sinus shallow, keel slightly arched, forming a very obtuse angle with the postical margin of the lobe; cells of lobe plane or a little convex, averaging 12 μ at the margin, 24 × 18 μ in the middle and 28 × 18 μ at the base, trigones large, triradiate with rounded ends, separated from the oblong to circular intermediate thickenings by narrow pits: underleaves distant to loosely imbricated, appressed on the caudex but more or less squarrose on the secondary stems and sometimes revolute at the apex and along the sides, broadly orbicular-obovate, averaging 0.35 mm. in length and 0.4 mm. in width, cuneate at the base, rounded to subretuse at the apex: inflorescence polyoicous: ♀ inflorescence terminating a secondary stem or one of its leading branches, innovating on one side or rarely on both, the innovations short and sterile or soon again floriferous, rarely terminating in an antheridial spike; bracts erect-spreading, deeply and unequally bifid, complicate, the lobe oblong-obovate, 0.95 mm. long, 0.5 mm. wide, more or less convex and often revolute along the postical margin and at the apex, lobule ovate to ligulate, 0.4 mm. long, 0.15 mm. wide, rounded to subacute at the apex, keel very short; bracteole obovate, averaging 0.75 × 0.4 mm., rounded to retuse at the apex; perianth about half exserted, oblong-obovate in outline, cuneate toward the base, 1.4 mm. long, 0.75 mm. wide, antical keel low and broad, lateral and postical keels high and sharp, usually bearing narrow wings from one to three cells wide and variously sinuate or subcrenulate on the margin: ♂ inflorescence terminating a short branch, apparently not proliferating; bracts loosely imbricated, mostly in from three to six pairs, unequally bifid, the lobe oblong to rounded at the apex, lobule similar but shorter and narrower, keel strongly arched; antheridia in pairs; bracteoles similar to the underleaves but smaller: capsule about 0.4 mm. in diameter, yellowish-brown; spores greenish, irregular in form, about 16 μ in short diameter, minutely verruculose; elaters 9 μ in diameter. (PLATE 8, FIGURES 1–8.)

On a log. El Yunque, *Evans* (*140*). Type locality: Caracas, Venezuela (herb. Hampe). The species has also been found on the island of Great Bahama, *Britton & Millspaugh*. The type material preserved in the Lindenberg herbarium agrees closely with the Puerto Rico and Bahamian specimens.

Archilejeunea viridissima is closely related to *A. Auberiana*. Through the kindness of M. Paul Hariot the writer has been supplied with a portion of the original material of the latter species from the Montagne herbarium. It shows an autoicous inflorescence and agrees with *A. viridissima* in size, habit, and color.

The lobules in both species are normally bidentate, and the perianths are five-carinate with smooth or nearly smooth keels. The lobule in *A. Auberiana*, however, is subrectangular in outline rather than ovate, the keel being nearly straight, and the marginal teeth tend to be larger and more pronounced than in *A. viridissima*. The leaf-cells also offer certain points of distinction, although they average about the same in size. In *A. Auberiana* the local thickenings of the walls are rarely confluent, the trigones are mostly in the form of equilateral triangles with straight sides, and the intermediate thickenings are oval or circular in outline. In *A. viridissima*, on the other hand, the thickenings are more frequently confluent, the trigones show a strong tendency to be triradiate, with rounded and often constricted rays, and the intermediate thickenings show a similar tendency to be rectangular, with rounded ends. *A. Auberiana* is further characterized by the lobules of its perichaetial bracts; these are much smaller than in *A. viridissima* and are usually adnate to the lobes throughout their entire length. Although the differences which have just been enumerated are slight, they seem to be constant.

Another allied species is *Lejeunea florentissima* Spruce, which the writer would keep distinct from *A. Auberiana*. This species is more robust than *A. viridissima*, and the lobes of the leaves are more falcate; the keel of the lobule is parallel with the free margin, but both are more or less curved; the trigones in the leaf-cells are similar to those in *A. Auberiana* but are better developed, the sides of the triangles being convex rather than straight. The subfloral innovations in *L. florentissima* are usually soon floriferous and the perianths are thus crowded together in a cymose cluster; in *A. viridissima* the arrangement of the perianths is much more irregular.

LEUCOLEJEUNEA

The characters of the genus *Leucolejeunea*, recently segregated by the writer from *Archilejeunea*, have already been so fully discussed * that it hardly seems necessary to enumerate them here. Five species are definitely known at the present time, the generic type being *L. clypeata* (Schwein.) Evans, a widely distributed species in the eastern United States. The only representative of

* See Torreya 7: 225–229. 1908.

the genus which has been found in Puerto Rico is *L. xanthocarpa*, although *L. unciloba* (Lindenb.) Evans is surely to be expected on the island.

LEUCOLEJEUNEA XANTHOCARPA (Lehm. & Lindenb.) Evans

Jungermannia xanthocarpa Lehm. & Lindenb. in Lehmann, Pug. Plant. **5**: 8. 1832.

Lejeunea xanthocarpa Lehm. & Lindenb.; G. L. & N. Syn. Hep. 330. 1845.

Lejeunea (*Archi-Lejeunea*) *xanthocarpa* Pears. Christiana Vidensk.-Selsk. Forh. **1887**[9]: 4. *pl. 1. f. 14–24.*

Archilejeunea xanthocarpa Schiffn. Conspect. Hepat. Archip. Indici 316. 1898.

Leucolejeunea xanthocarpa Evans, Torreya **7**: 229. 1908.

Pale glaucous-green, varying to bright-green and becoming yellowish or brownish upon drying, growing in depressed mats: stems 0.15 mm. in diameter, the branches obliquely to widely spreading, with smaller leaves than the stem but not microphyllous, sterile branches mostly simple or sparingly subdivided: leaves imbricated and usually densely so, the lobe (when flattened out) orbicular-ovate, 1 mm. long, 0.85 mm. wide, convex and strongly revolute at the broad and rounded apex and along the whole postical margin, antical margin straight or slightly rounded at base, then outwardly curved to the apex; lobule narrowly ovoid, 0.4 mm. long, 0.2 mm. wide, gradually contracted in the outer half, the water-sac opening directly into the revolute portion of the lobe, keel straight or slightly arched continuous with revolute portion or slightly indented at junction, apex (not visible without flattening or dissection) varying from bluntly pointed to acuminate, in the latter case tipped with a row of from two to four cells, sinus straight or slightly lunulate, hyaline papilla mostly three to six cells from the apex; cells of lobe plane or slightly convex, averaging 14 μ at the margin, 20 μ in the middle, and 28 × 20 μ at the base: underleaves imbricated, plane (or a little convex from below), reniform, 0.5 mm. long, 0.7 mm. wide, rounded to cordate at the base, rounded to vaguely retuse at the apex: ♀ inflorescence borne on a more or less abbreviated branch, sometimes with only one pair of leaves below the involucre, innovating on one side; bracts erect-spreading, the lobe falcate, convex, revolute at the rounded apex and along the postical margin, oblong-obovate, 1 mm. long, 0.6 mm. wide, lobule oblong, 0.4 mm. long, 0.2 mm. wide, rounded to subacute at the apex, keel sometimes narrowly winged; bracteole broadly obovate, 0.95 mm. long, 0.75 mm. wide, slightly

retuse at the apex; perianth almost hidden by the involucre, 1 mm. long, 0.7 mm. wide, narrowed toward the base, rounded to slightly retuse at the apex, beak 0.1–0.15 mm. long, keel roughened by projecting cells but destitute of wings or distinct teeth: ♂ inflorescence as described under the genus. (PLATE 7, FIGURES 12–23.)

On trees. Near Cayey, *Evans* (76). The species is also known from the following islands of the West Indies: New Providence, Bahamas, *A. E. Wight, E. G. Britton;* Jamaica, *Underwood, Evans;* Guadeloupe, *Husnot, Duss;* Dominica, *Elliott;* Martinique, *Duss.* On the American continent its range extends from Mexico to Brazil (the type locality). There are also records from Java and from Fernando Po, Mount Kilimanjaro and Cape Colony in Africa. A fragment of the type specimen in the Lindenberg herbarium, collected by Beyrich in 1823 at New Freiburg, Brazil, agrees closely with the specimens here described.

Apparently the closest allies of *L. xanthocarpa* are *L. unciloba*, which has already been mentioned, and *L. conchifolia* Evans.* Both of these species have convex lobes and long teeth at the apices of the lobules. In *L. unciloba*, however, the apex of the lobe is only slightly revolute, and the apical tooth of the lobule is easily visible without dissection. In *L. conchifolia* the plants are less robust than in *L. xanthocarpa*, the lobes of the leaves spread more obliquely, the lobules are relatively larger, and their apical teeth are more like those of *L. unciloba*, being readily demonstrated without dissection. *L. xanthocarpa* also bears a strong superficial resemblance to *Pycnolejeunea Schwaneckei* (Steph.) Schiffn., which is of course at once distinguished by its bifid underleaves.

ANOPLOLEJEUNEA

The genus *Anoplolejeunea*, as defined by Schiffner, contains the single species *A. herpestica* (Spruce) Schiffn. Apparently nothing has been written about this species except the rather brief descriptions of Spruce and Schiffner. The writer finds, however, upon examining a portion of the type material of *A. herpestica*, kindly

*For descriptions and figures of these two species see Evans, Mem. Torrey Club 8: 125–129. *pl. 16. f. 12–20; pl. 17. f. 1–9.* 1902. *L. unciloba* is there called *Archilejeunea Sellowiana* Steph., a species which the writer now considers synonymous with the much older *Lejeunea unciloba* Lindenb. See also Torreya 7: 229. 1908.

sent by Mr. M. B. Slater, that it is quite indistinguishable from the widely distributed *Lejeunea conferta* Meissn. Although placed by recent writers in *Archilejeunea*, *L. conferta* cannot be considered congeneric with the typical members of this genus, and there seem to be excellent reasons for maintaining *Anoplolejeunea* as distinct. Spruce compares it with his subgenus *Platy-Lejeunea*, but it is evidently much more closely related to the genus *Leucolejeunea*.

The plants grow in depressed mats and are either pale- or dark-green in color with neither glossiness nor pigmentation. The prostrate stem is copiously and irregularly branched, some of the branches being similar to the stem while others are ascending and distinctly microphyllous (PLATE 8, FIGURE 9). The normal leaves are imbricated, the convex lobe spreading widely and showing a rounded apex and entire margin. The leaf-cells are plane or nearly so, with small trigones and occasional intermediate thickenings (FIGURE 16), and ocelli are sometimes present at the base of the lobe (FIGURE 17).

The lobule when normally developed is more complicated than in most of the other genera of the *Lejeuneae*. It is ovate-oblong in outline and forms a strongly inflated water-sac with an arched and convex keel (FIGURE 9). From a relatively short base it is abruptly dilated and becomes suddenly contracted in the outer part. The dilated portion, bounded by the rounded and entire free margin, forms a volute with about one and a half turns (FIGURE 14). This comes into contact with the lobe, thus enclosing the water-sac, but the margin itself, together with a considerable extent of the lobule, lies free within the sac and can be distinguished by careful focusing from below. The lobule develops no apical tooth, the free margin being directly continuous with the sinus; just at the junction of the two, however, a cell may be observed which is a little larger than its neighbors and which doubtless represents the terminal cell of the lobule, homologous with the apical tooth of other *Lejeuneae* (FIGURE 18). At the beginning of its course the sinus is also strongly revolute but straightens out abruptly and passes into the postical margin of the lobe at the end of the keel. The hyaline papilla is marginal and arises from the terminal cell, usually at its junction with the first cell of the sinus; it may therefore be regarded as distal in posi-

tion. Unfortunately, the lobule is often poorly developed and fails to show some of the peculiarities which have just been described.

The underleaves are distant and smaller than is usual among the *Holostipae*. They are obovate and entire, the apex varying from truncate to slightly retuse. When rhizoids are developed they usually spring from a distinct basal radicelliferous disc.

The inflorescence is dioicous, and the male and female plants usually occur in separate mats. The female branch varies greatly in length and nearly always give rise to one or two subfloral innovations. In rare cases, however, the branch remains perfectly simple. The perichaetial bracts are a little larger than the leaves and their lobes are relatively narrower ; the lobules are rounded to subacute and the sharp keels are narrowly winged. The bracteole is free and mostly obovate-oblong in outline, the apex varying from rounded to slightly retuse (FIGURES 19, 21). The perianth is obovoid and normally shows five sharp keels (FIGURE 23) and a short but distinct beak. The male inflorescence occupies a short branch or is terminal on a more or less elongated branch. The bracts are imbricated and diandrous, and the bracteoles are limited to the base of the spike.

Anoplolejeunea conferta (Meissn.)

Jungermannia conferta Meissn.; Sprengel in Linnaeus, Syst. Veg. ed. 16. **4**: 325. 1827.

Lejeunea subaurita Nees & Mont. Ann. Sci. Nat. Bot. II. **5**: 60. 1836.

Lejeunea Miquelii Lehm. & Lindenb. in Lehmann, Pug. Plant. **7**: 15. 1838.

Lejeunea proteoides Lehm. & Lindenb, *l. c.* **7**: 19. 1838.

Lejeunea conferta Meissn. ; G. L. & N. Syn. Hep. 333. 1845.

Lejeunea involutiloba Mont. Ann. Sci. Nat. Bot. IV. **5**: 350. 1856.

Lejeunea (*Anoplo-Lejeunea*) *herpestica* Spruce, Hep. Amaz. et And. 129. 1884.

Lejeunea (*Platylejeunea*) *conferta* Steph. Hedwigia **27**: 284. 1888.

Lejeunea (*Archi-Lejeunea*) *conferta* Steph. *l. c.* **29**: 21. 1890.

Anoplolejeunea herpestica Schiffn. in Engler & Prantl, Nat. Pflanzenfam. **1**^{3}: 131. 1895.

Archilejeunea conferta Schiffn. Conspect. Hepat. Archip. Indici 315. 1898.

Plants becoming yellowish or brownish upon drying: stems 0.17 mm. in diameter, branches obliquely to widely spreading: leaves imbricated, the lobe widely spreading, often revolute at the apex, falcate, broadly ovate, 1 mm. long, 0.85 mm. wide when of maximum size, often considerably smaller, arching across or a little beyond the axis, antical margin straight or slightly incurved near the base, then strongly outwardly curved to the apex, postical margin straight or somewhat curved, not revolute, forming an angle of 90 degrees or more with the strongly arched keel; lobule 0.35 mm. long, 0.2 mm. wide; cells of lobe averaging 17 μ at the margin, 25 μ in the middle and 40 × 25 μ at the base, trigones triangular with concave sides, intermediate thickenings sometimes confluent with the trigones; ocelli (when present) mostly one to three, situated near the base of the lobe, measuring about 45 × 32 μ: underleaves broadly orbicular-obovate, 0.35 mm. long, 0.35–0.4 mm. wide, plane, cuneate and short-decurrent at the base: perichaetial bracts erect-spreading, the lobe obovate from a narrow base, 1.2 mm. long, 0.7 mm. wide, convex and revolute at the apex, rounded to obtuse at the apex, lobule ovate-oblong, 0.75 mm. long, 0.25 mm. wide; bracteole 0.4–0.75 mm. long, 0.25–0.4 mm. wide; perianth about two-fifths exserted at maturity, 1–1.3 mm. long, 0.7–0.75 mm. in diameter, apex variable, usually truncate or subretuse but sometimes rounded or even subacute, keels variable, sometimes low and almost obsolete, sometimes distinctly dilated in the upper part, when well developed showing a marginal row of slightly projecting cells with strongly thickened walls, postical surface of perianth sometimes developing one or two low and supplementary keels or folds: ♂ inflorescence apparently never proliferating; bracts mostly in from two to seven pairs, closely imbricated, inflated, shortly bifid, the lobe strongly convex, rounded at the apex, antical margin straight or a little incurved, keel strongly arched, lobule obtuse to acute at the apex; bracteoles similar to the underleaves but smaller: mature sporophyte not seen. (PLATE 8, FIGURES 9–23.)

On trees. Puerto Rico, without definite locality, *Sintenis (100)*. The writer has seen no specimens of *A. conferta* from Puerto Rico but has collected it abundantly on the island of Jamaica, where it occurs at elevations of from 1,000 to 2,000 m. The species was originally collected in Peru but is now also known from Brazil, Bolivia, Venezuela, Trinidad, Colombia, and Mexico. Whether it occurs outside of tropical America is somewhat doubt-

ful. The Synopsis Hepaticarum cites it from the islands of Luzon and Java, and Schiffner also quotes the latter locality. Both of these records, however, are based on old collections.

The microphyllous branches of *A. conferta* (FIGURE 9) are very characteristic, although they are sometimes scantily developed and may even be absent altogether. The lobes of their leaves are orbicular-ovate in outline and average about 0.35 mm. in length; they are suberect or spread obliquely from the axis instead of spreading widely as on normal stems and branches. The lobules are nearly spherical and measure only 0.15 mm. in diameter, in other respects agreeing with those on typical leaves. The underleaves, except for their small size, present no distinctive peculiarities. Under certain circumstances the lobules are poorly developed even on the stems and leading branches (FICURE 12) and thus give rise to forms which are not always easy to recognize. Usually a careful examination will reveal a few lobules of normal structure scattered among the others, and these will aid in the determination of such anomalous specimens. The characters upon which the varieties *Miquelii* and *Lichmaniana* of the Synopsis are based are apparently drawn from imperfectly formed lobules, and the propriety of attempting to maintain them is doubtful.

In the specimens from Jamaica the lobes of the leaves are usually distinctly ocellate at the base except on poorly developed individuals. In all the South American specimens, however, which the writer has been able to examine, the ocelli are apparently absent. If this difference should prove to be constant it might necessitate the separation of the West Indian plant as a distinct species. Unfortunately the South American specimens were all of old collections, and the detection of ocelli in plants of this character is sometimes very uncertain. Under the circumstances it seems best to include the Jamaican specimens with the others, a course which is advocated also by Stephani.

A. conferta bears a rather strong superficial resemblance to *Leucolejeunea clypeata*, the two species agreeing in color and in many of the characters derived from leaf-cells, underleaves, perichaetial bracts, and perianths. They differ strikingly, however, in the structure of the lobule, and *L. clypeata* is also distinct in its inflorescence, which is normally autoicous, and in its lack of micro-

phyllous branches. There is little danger of confusing *A. conferta* with any other species of *Leucolejeunea*, in spite of the close relationship of the two genera.

The present paper concludes the discussion of the *Lejeuneae Holostipae* which are known to occur in Puerto Rico. Of the genera recognized by Schiffner the following four are apparently unrepresented on the island: *Ptychanthus*, *Thysananthus*, *Peltolejeunea* and *Dicranolejeunea*. The last of these genera is abundant on Jamaica at rather high altitudes and may therefore be expected to have a wider distribution in the West Indies. There is little probability, however, that any of the others will be found there, although each is represented in South America by one or more species. *Ptychanthus* and *Thysananthus*, in fact, are essentially paleotropic in their distribution and attain their highest development in the East Indies and the neighboring parts of Asia.

YALE UNIVERSITY.

Explanation of plates 6-8

As in the previous papers of this series the figures were drawn by the writer and prepared for publication by Miss Hyatt.

PLATE 6

Brachiolejeunea insularis Evans. Part of stem with branch, postical view, × 15. 2. Part of stem with base of branch, postical view, × 15. 3. Leaf, antical view, × 15. 4, 5. Perianths with involucres, the innovations dissected away, postical view, × 25. 6. Cells from middle of lobe, × 265. 7–9. Free margins of lobules, × 45. 10, 11. Apices of lobules, × 200. 12. Marginal teeth of lobule, × 200. 13. Stem-leaf at base of branch, × 15. 14. Basal auricle of underleaf, × 200. 15–17. Bracts and bracteole from one involucre, × 15. 18–20. Bracts and bracteole from another involucre, × 15. 21, 22. Transverse sections of perianths, × 35. Fig. 5 was drawn from specimen collected by Heller (*4463a*); Figs. 8, 9, 11, 18–20, from specimens collected by Howe (*465*); the remaining figures from the type specimen.

PLATE 7

Ptychocoleus polycarpus (Nees) Trevis. 1. Part of stem with base of a branch, postical view, × 15. 2. Apex of female branch with perianth, postical view, × 15. 3. Part of stem, antical view, × 15. 4. Cells from middle of lobe, × 265. 5. Margin of lobule, the apex on right, × 200. 6–8. Bracts and bracteole from the same involucre, × 15. 9. Subfloral leaf below involucre, × 15. 10. Bracteole from another specimen, × 15. 11. Transverse section of perianth, × 25. The figures were all drawn from specimens collected by Howe (*1411*, *1414*).

Leucolejeunea xanthocarpa (Lehm. & Lindenb.) Evans. 12. Part of sterile stem, postical view, × 15. 13. Part of plant with perianth, postical view, × 25. 14. Part of stem, antical view, × 15. 15. Leaf with lobule flattened out, × 15. 16. Cells from middle of lobe, × 265. 17. Cells from antical margin of lobe, × 200. 18, 19. Apices of lobules, × 200. 20–22. Bracts and bracteole from the same involucre, × 25. 23. Transverse section of perianth, × 35. The figures were all drawn from specimens collected by the writer (*76*).

PLATE 8

Archilejeunea viridissima (Lindenb.) Evans. 1. Apex of female stem with perianth, postical view, × 25. 2. Part of caudex, postical view, × 25. 3. Cells from middle of lobe, × 265. 4. Margin of lobule, the apex on right, × 200. 5, 6. Bract and bracteole from the same involucre, × 25. 7. Bract from another involucre, × 25. 8. Transverse section of perianth, × 25. The figures were all drawn from specimens collected by the writer (*140*).

Anoplolejeunea conferta (Meissn.) Evans. 9. Part of sterile stem with microphyllous branches, postical view, × 25. 10. Female branch with perianth, postical view, × 25. 11. Apex of male branch, postical view, × 25. 12. Branch with poorly developed lobules, postical view, × 25. 13. Lobule, postical view, × 45. 14. Longitudinal section through lobe and lobule, × 45. 15. Mouth of lobule, diagrammatic. 16. Cells from middle of lobe, × 265. 17. Cells from base of lobe, enclosing an ocellus. × 200. 18. Margin of lobule, apical end on left, × 200. 19. Perianth with involucre, postical view, × 35. 20, 21. Bract and bracteole from a single involucre, × 25. 22. Perianth, postical view, × 25. 23. Transverse section of perianth, × 35. The figures were all drawn from Jamaican specimens collected by the writer (*43*, *272*, *424*).

The ferns and flowering plants of Nantucket — II

Eugene P. Bicknell

GRAMINEAE

One hundred and four grasses are here enumerated and a number of varieties are indicated, some of which should perhaps bear distinctive names. Other species which flower only in the spring or early summer are doubtless to be added. In no other family of plants represented on Nantucket are introduced species more likely to appear and from this source the list should be considerably augmented as time goes on.

It is to be understood that when not otherwise stated the species referred to were found in perfect flowering or fruiting condition.

Schizachyrium scoparium (Michx.) Nash.

Andropogon scoparius Michx.

Abundant, often the dominant grass over extensive tracts on the plains. Near Miacomet Pond a slender, thinly tufted form occurred, here and there, in which the colors were bright-green and yellowish in striking contrast to the duller green and purple of the prevailing plant. This light-colored form showed nowhere the slightest purple tinge and was palest in those parts ordinarily the most deeply colored, especially the internodes, leaf-sheaths, and spikelets.

* Schizachyrium villosissimum (Kearney) Nash.

Andropogon scoparius villosissimus Kearney, U. S. Dept. Agric. Div. Agrost. Bull. **24**: 41. Ja 1901.

Common on sandy plains, roadsides, and in open pine scrub, often growing with *S. scoparium* and always readily distinguishable from it by its villous sheaths and leaf-blades. When both are fully mature, they may be distinguished at sight by a different appearance of their spikes due mainly to a somewhat denser and whiter bearding of the sterile pedicel in *S. villosissimum*.

The reference of this Nantucket grass to *S. villosissimum*, not hitherto reported from north of the Carolinas, is based on the

original description, no actual comparison having been made with type material.

* **Schizachyrium littorale** (Nash) comb. nov.

Andropogon littoralis Nash, in Britton, Man. 69. 1901.

'Sconset; Polpis. Specimens collected are less notably different from *S. scoparium* than are strongly developed examples from the Long Island and New Jersey coasts.

ANDROPOGON ABBREVIATUS Hack.

Common and widely distributed in low grounds. In some seasons not flowering until September.

ANDROPOGON VIRGINICUS L.

Common on the level tract below the "Cliff," elsewhere apparently infrequent.

ANDROPOGON FURCATUS Muhl.

Rather common in Squam, sparingly in Polpis and near Acquidness Point; not met with elsewhere.

SORGHASTRUM AVENACEUM (Michx.) Nash.

Rather common on the eastern side of the island and locally elsewhere: Abram's Point; Polpis; Squam; 'Sconset; South Pasture; the Woods; Long Pond, often only freshly in flower at the middle of September.

* PASPALUM PSAMMOPHILUM Nash. (A. S. Hitchcock, Rhodora 8: 205. 1906.)

Paspalum prostratum Nash, not Scribn. & Merr.

Common and generally distributed, often growing in pure sand. Near Gibbs' Pond plants were measured which covered a diameter of 4 to 5½ feet with their prostrate radiating stems.

PASPALUM SETACEUM Michx.

Not uncommon, but rather local: Squam; Pocomo; Quaise; near the town; Long Pond and elsewhere. Spikelets glabrous, or the convex scale ciliolate near the apex, mostly oval and 1.5 mm. long. In the usual form the larger leaves are commonly 3–6 mm. wide and the spikes 4–7 cm. long; very vigorous plants by a roadside near Long Pond had spikelets 1.75 mm. long, spikes 5–10 cm. in length, and leaves 5–13 mm. wide.

* PASPALUM MUHLENBERGII Nash.

Rather common. The usual form has the leaves 4–8 mm. wide, and rarely more than a single spike on the slender peduncle, which is sometimes thinly pilose. At Shawkemo in damp soil a few plants were met with having somewhat inflated sheaths, leaves 6–15 cm. wide, and shorter, pilose peduncles bearing twin spikes.

The Nantucket plant sometimes seems to show a close approach to *P. pubescens* Muhl.

* SYNTHERISMA FILIFORME (L.) Nash.

Common in sandy soil, especially in the neighborhood of the town, extending along roadsides to far-outlying points, as near Wauwinet and Long Pond.

SYNTHERISMA HUMIFUSUM (Pers.) Ryd.

Very common generally, often in abundance along sandy roadsides.

SYNTHERISMA SANGUINALE (L.) Dulac.

Very common.

ECHINOCHLOA CRUS-GALLI (L.) Beauv.

Common, mostly about and near the town and in the vicinity of cultivated ground. About the shores of ponds on the south side of the island occurs a form often much dwarfed and sometimes quite prostrate in the sand, having numerous reduced panicles, and spikelets like the common barnyard plant but very shortly awned.

* ECHINOCHLOA CRUS-GALLI MUTICA Vasey.

Met with several times in or near the town, rather a small form, the panicle sometimes reduced to 4–6 simple subsecund short branches bearing loosely subsecund spikelets smaller than in *E. Crus-galli* proper, with less hispid and awnless, acute or mucronate scales.

ECHINOCHLOA WALTERI (Pursh) Nash.

Occurs sparingly with *E. Crus-galli* in brackish soil about ponds on the south shore. Growing with it was a reduced form, appearing like a hybrid with *E. Crus-galli*, in which the sheaths were glabrous or the lowest minutely pubescent but not at all papillose. Not flowering until late August or September.

* PANICUM CAPILLARE L.

Uncommon, but slowly spreading. In 1899 only two plants were met with, one near the town and one at 'Sconset; in 1904 a few plants were seen in old fields on both sides of the town, one plant about three miles out on the Wauwinet road and one at 'Sconset; in 1907 single plants were noticed at several places in the town, as well as at a few outlying points.

PANICUM MILIACEUM L.

Near the town by the road to Surfside, 1899; not seen on any subsequent visit. Collected on Nantucket by Walter Deane, Sept. 9, 1885. (Hitchcock, Rhodora 3: 100. 1901.)

PANICUM PROLIFERUM Lam.

Very common, especially so on sandy pond shores, where it often occurs in a much dwarfed condition.

PANICUM VIRGATUM L.

Very common. A reduced form was found growing in sterile soil in open pine-scrub east of Miacomet Pond: culms ascending at base, sometimes not over 4 dm. high; leaves firm and stiff, pale glaucescent-green; panicle small and contracted, the short branches appressed, sometimes 10 cm. long and only 1 cm. wide, sometimes reduced to a few sparsely flowered branches; spikelets small, 2.5–3 mm. long, the scales shorter, broader, less attenuate and less distinctly nerved than in the usual plant, the first scale relatively shorter, all the scales with less evident and more appressed tips.

Panicum anceps Michx. has been recorded from Nantucket; it would seem to be quite possible that the reduced form of *P. virgatum* described above, with its decumbent base, stiff, pale leaves, and contracted panicle, may have led to misidentification.

* PANICUM AGROSTOIDES Spreng.

Damp roadside below the "Cliff"; by a pool east of the town and in abundance by two pools north of the town; wet spot in the "Woods."

PANICUM DEPAUPERATUM Muhl.

Common; specimens collected are more or less villous with flat leaves and many basal panicles, the spikelets decidedly beaked and 3.5–4 mm. long.

* PANICUM LINEARIIFOLIUM Scribn.

Fully typical *P. lineariifolium* was not met with. The grass here referred to it, with reservations, was collected several times and is somewhat intermediate between *P. lineariifolium* and *P. depauperatum*. Nevertheless, I do not myself doubt the distinctness of these two grasses, believing that they represent a group of closely related species which will continue to be troublesome in classification until their proper lines of segregation are understood.

The Nantucket plant has much the habit and pubescence of *P. lineariifolium*, with the spikelets not larger than in that species and sometimes as pubescent, but the venation and shape of the flowering scales are more those of *P. depauperatum*, as a rule, however, wanting the pronounced beak-like termination which is so marked a feature of the latter. The spikelets are rather broadly ovoid, 2–2.5 mm. long, obtuse or subacute, the larger scales usually but not always slightly surpassing the grain.

* **Panicum Owenae** sp. nov.

Tufted, erect or ascending; culms 1.5–3.25 dm. high, slender, often geniculate at the nodes; nodes 2 or 3, bearded with a ring of appressed or ascending white hairs; lowest internodes appressed soft-pubescent, the upper ones and peduncle minutely close-puberulent; basal leaves short-lanceolate, 3–4 mm. wide, sparsely papillate-long-ciliate at base; stem-leaves 2 or 3, linear-lanceolate, ascending, 1.5–3 mm. wide, 4–10 cm. long, closely striate-nerved, minutely scabrellous-puberulent above, softly appressed-puberulent and sometimes also thinly pilose beneath and sparsely long-ciliate, attenuate, finally involute; ligule a dense fringe of hairs; sheaths striate, more or less puberulent, the lowermost often papillate-pilose; primary panicle 2–6 cm. long, puberulent, its branches ascending, the lowest usually solitary; branches of the culm slender, sometimes 6 cm. long, bearing clusters of stiff, crowded, linear, attenuate leaves and numerous spikelets; spikelets 1.5–2 mm. long, oval, occasionally orbicular or oblong, very obtuse, first scale $\frac{1}{3}$–$\frac{1}{2}$ the length of the subequal second and third, strongly 1-nerved and acute to 3-nerved, sometimes obtuse, second scale 7–9-nerved, third scale 7-nerved, all minutely soft-puberulent with subappressed hairs; caryopsis white, elliptic, 1.25–1.50 mm. long.

Type collected September 20, 1907, on the sandy commons west of the town, deposited in herb. N. Y. Bot. Garden. A specimen collected September 11, 1899, is smaller and more densely

tufted, with numerous secondary branches and panicles among the crowded basal leaves. Named in compliment to Mrs. Maria L. Owen, whose name is already inseparably connected with the study of the Nantucket flora.

An interesting *Panicum*, connecting the *depauperatum* and *dichotomum* groups, and related to both *P. linearifolium* and *P. Bicknellii*. Its relationship to the latter does not readily appear from its general aspect but becomes evident on closer study. The essential differences are the much smaller, obtuse, instead of acute, spikelets, much narrower leaves pubescent beneath, soft-puberulent culm and panicle, secondary panicles on branches bearing close tufts of short leaves, generally smaller proportions, and greater amount of pubescence throughout.

* PANICUM BICKNELLII Nash.

A large, spreading, nearly prostrate tuft growing among *Ammophila* on a wide sandy tract on Little Neck, September 14, 1906. Spikelets remaining only on the secondary panicles.

This grass would seem to be almost out of place on Nantucket, although it is less exclusively an inhabitant of open rocky woods than has been supposed, for it occurs, also, though rarely, in open sandy fields on Long Island.

The Nantucket plant is not in the least doubtful, although the prostrate position and unusually firm and roughened leaves are noteworthy: larger culms 5 dm. long, leaves mostly 3–5 mm. wide, 6–10 cm. long, firm, scabrellous on the upper surface, becoming involute toward the apex or even narrowed to a terete attenuation, at least the lower leaves sparsely ciliate towards the base; internodes puberulent; lower nodes slightly bearded; sheaths glabrous or obscurely pubescent, the margins somewhat pilose; panicle scabrous, 6–9 cm. long; culm glabrate; spikelets 2.5 mm. long, acutish, puberulent, the nervation formula, 1, 9, 7.

* PANICUM DICHOTOMUM L.

Apparently rare, and met with only on the moors near the fifth mile post of the railroad — the common woodland plant. It appears smooth and glabrous throughout, but actually the sheaths of the short basal leaves are appressed-pilose and the lowermost internodes sometimes obscurely puberulent; there are also often a few long, erect or reflexed white hairs at the base of the leaf,

especially on the branches, where the sheaths are also sparsely pilose; leaves spreading, 2–5 mm. wide; spikelets glabrous, 2 mm. long.

* PANICUM COLUMBIANUM Scribn.

Rather common in dry open places or in partial shade among scrub-oaks and pines.

Among the related species on Nantucket, this is especially marked by the fine, close puberulence of the slender purplish internodes, which often appears more like a glaucescent bloom than a pubescence. The lowermost internodes are, however, sometimes densely appressed-pubescent, and specimens which approach *P. meridionale* in still other characters denote a very close relationship. The leaf-blades are either glabrous or close-puberulent on the lower surface; the spikelets are 1.5–1.75 mm. long.

* PANICUM MERIDIONALE Ashe.

Panicum filiculme Ashe.

Panicum oricola Hitchc. & Chase, Rhodora 8: 208. N 1906.

Perhaps the most common *Panicum* of Nantucket, growing everywhere in dry sand or sandy soil. Its preference would appear to be for exposed sandy or gravelly levels, but it mingles freely with the close low growth which covers the moorland and hillsides and finds its way into half-shaded openings among the pine groves. Responding to this diversified habitat it shows so great a degree of variation that extreme forms might confidently be taken for distinct species. From one to another of the most divergent forms, however, gradation appears to be so complete and so general that, although not convinced of their actual interrelation, I have found no assured basis for treating them otherwise than as conditions or states of a single rather broad species.

Three pronounced variants are here especially referred to: One is the plant of exposed sandy places. It is either erect or prostrate and readily forms close mat-like tufts; the pubescence is densely appressed-pilose on the sheaths and internodes and almost velvety on the lower surfaces of the primary leaves, although the later leaves may be quite glabrous; the panicles are sometimes long-peduncled but mostly little or not at all exserted. This seems to be the plant recently described as *P. oricola* Hitchc. & Chase.

A second well-defined variant grows in weakly spreading ascending or erect tufts and is closely much-branched; the leaves are thinner, softer, and more pilose than in the plant first described and more loosely soft-pubescent on the lower surface, and the sheaths and internodes are often conspicuously and densely villous; the panicles are short-peduncled or included, usually with slender-pedicelled spikelets. Certain examples of this form are almost identical with specimens of *P. meridionale* collected by Ashe in North Carolina. Other examples seem to meet precisely the description of *Panicum unciphyllum thinium* Hitchc. & Chase, Rhodora 8: 209. N 1906.

A third marked form is the plant of the dry overgrown commons and moorland. This corresponds closely with specimens of *P. filiculme* named by Ashe. It is much more slender than the contrasted forms, with much sparser and looser pubescence and very narrow, firm, pale-green leaves; the small panicle is commonly long-peduncled. Very diminutive forms of this occur, in which the panicle is wholly included. In this and in the form first mentioned the primary panicles have mostly lost all their spikelets before the end of August.

A study of these several forms in their early flowering stages would doubtless throw considerable light on their mutual relationships.

PANICUM UNCIPHYLLUM Trin.

Frequent or common in low grounds or grassy places. Primary panicles with few or no spikelets remaining. A reduced and slender form occurs in cranberry bogs and sandy wet places; it is more sparsely and loosely pubescent than the usual form, with the leaves narrower, firmer, and paler green.

*PANICUM TENNESSEENSE Ashe.

Included under this name are specimens of a *Panicum* very closely related to *P. unciphyllum*, which, judging from herbarium material, seems to be now quite generally referred to *P. tennesseense*. It is uncommon on Nantucket, where two definite forms are to be noted: one is rather thinly villous-pubescent and has slender ascending culms not branched from the lower nodes, and thin, rather bright-green leaves minutely but not densely pubescent on the lower surface. This was found only in woods on

Coskaty. The other form, met with sparingly at 'Sconset and Wauwinet, is more softly and densely pubescent, with firmer, duller-green leaves, sometimes 8 mm. wide, and is branched from the base and sometimes quite prostrate. In both forms the partly included primary panicles were freshly in flower.

* PANICUM ATLANTICUM Nash.

Frequent or rather common in dry grassy places, sometimes growing with *P. Scribnerianum*. After the middle of August spikelets remain only on the secondary panicles.

On Saul's Hills a greener form with unusually narrow and long-attenuate leaves was collected.

PANICUM SCRIBNERIANUM Nash.

Common in dry sandy fields; secondary panicles only.

* PANICUM SPHEROCARPON Ell.

Common in dry places; panicles often perfectly fresh.

PANICUM CLANDESTINUM L.

Locally common in low grounds but by no means generally distributed. Past flowering.

* PANICUM MATTAMUSKETENSE Ashe.

Panicum Clutei Nash.

Common in cranberry bogs and open wet places. After the middle of August few spikelets remain on the primary panicles. Very variable, either stout or slender, sometimes only 4 dm. high with leaves 4–6 mm. wide and panicles 4–6 cm. long, again 8–10 dm. tall, the leaves 10–14 mm. wide, becoming 11 cm. long, and panicles 8–10 cm. in length. On Nantucket this little-known grass is usually smaller than the same species on Long Island and in New Jersey, and differs also in a marked tendency towards firmer and paler green leaves, smaller, fewer-flowered panicles, and generally reduced pubescence. It is sometimes strongly suggestive of a modified open ground form of *Panicum boreale* Nash.

Panicum Clutei Nash has been attributed to Nantucket and held to be distinct from *P. mattamusketense* (Scribner & Merrill, Rhodora **3**: 95, 97, 119, 120. My 1901). The type specimen of the former in herb. N. Y. Bot. Garden can be distinguished by no material character from authentic examples of *P. mattamusketense* from North Carolina. The latter is somewhat more

pubescent with more densely bearded nodes but in respect of pubescence the plant is extremely variable even in the same locality, as I have repeatedly observed on Long Island, where the species is common.

* CHAETOCHLOA GLAUCA (L.) Scribn.

Common in cultivated fields and about the wharves and streets.

* CHAETOCHLOA VERSICOLOR Bicknell.

A characteristic grass of the borders of salt marshes.

CHAETOCHLOA VIRIDIS (L.) Scribn.

Rather common, mostly near cultivated ground.

* CHAETOCHLOA ITALICA (L.) Scribn.

A few plants in an old field near the town in 1899 — the smaller purple-awned form.

* CENCHRUS TRIBULOIDES L.

Scattered over a sandy level near an abandoned barn at Shawkemo Spring, Sept. 11, 1907. Perhaps introduced.

ZIZANIA AQUATICA L.

Considerable growths of this grass are established on the borders of head of Hummock Pond; Miacomet Pond, 1899. Leaves 1.5–3 cm. wide; branches of pistillate part of inflorescence either ascending or appressed.

Mrs. Owen says "Probably all introduced from seed sown about 1875."

HOMALOCENCHRUS ORYZOIDES (L.) Poll.

Common in low ground.

ANTHOXANTHUM ODORATUM L.

Common and widely spread; inflorescence completely dried.

* SAVASTANA ODORATA (L.) Scribn.

Common in salt marshes along the "Creeks"; sterile culms and leaves green, the fertile culms withered, often with persisting panicles.

ARISTIDA DICHOTOMA Michx.

Very common in sterile soil.

* ARISTIDA GRACILIS Ell.

Damp roadside west of the town, 1904.

ARISTIDA PURPURASCENS Poir.

A very common and characteristic grass of dry levels and barrens.

STIPA AVENACEA L.

Dry levels near head of Tom Never's swamp, 1904; only a single spikelet found, dried and accidentally persistent; east of Almanac Pond, Sept. 1907, leaves only.

MUHLENBERGIA MEXICANA (L.) Trin.

Sparingly by borders of yards and street-sides in town — the much-branched leafy form with numerous, lateral, flattened, short-branched panicles; defined as the type of *M. mexicana* by Scribner (Rhodora 9: 18. F 1907).

M. diffusa Schreber, reported in Mrs. Owen's catalogue as having been noticed in a yard in Orange Street, should possibly be referred to the above species, which occurs in yards along this same street.

PHLEUM PRATENSE L.

Common, spikes mostly dried.

ALOPECURUS PRATENSIS L.

Admitted to Mrs. Owen's catalogue; I saw nothing of it.

* SPOROBOLUS VAGINAEFLORUS (Torr.) Wood.

Found only in a sandy spot about one mile out on the road to Surfside; here it was growing sparingly in 1899 and subsequent years. Comes into flower perhaps later in the year than any other grass found on the island; at the middle of September 1907 it was not yet in bloom and in other years was only beginning to bloom towards the middle of the month.

AGROSTIS ALBA L.

Common; panicles dried. The prevailing plant is the reduced state — var. *vulgaris*, which abounds on the dry commons; the typical form occurs in richer soils. A lax form having more diffuse panicles and smaller spikelets is found in damp thickets.

* AGROSTIS MARITIMA Lam.

Very common in salt and brackish meadows. The usual form often grows in close masses, has very narrow leaves, with ligules often 5 mm. long, numerous slender culms, and contracted spike-like panicles 7–10 cm. long and less than 0.5 mm. thick. A stouter

form grows in close tufts and has geniculate, spreading, or ascending culms, and much more open, interrupted panicles often 1.5 dm. long and 2–4 cm. wide. Contrasting remarkably with these is a very definitely characterized form which was collected Sept. 2, 1904, on damp sandy levels by a pond on the south shore. It had produced numerous stolon-like leafy stems which crept over the sand for a distance of 1–2 feet and bore numerous short, firm leaves and short, leafy branches springing from many of the nodes; flowering culms 1.5–3.5 dm. in length, panicles close, narrowly oblong 3 6.5 cm. long, 0.5–1 cm. thick; leaf-blades 3–5 cm. long, 1–2 mm. wide, firm, rough on both surfaces and involute-attenuate at apex, ligule 1–1.5 mm. long; inflorescence, leaf-sheaths, and culms strongly tinged with purple. This grass agrees closely with the description of *Agrostis depressa* Vasey of the Northwest Coast (see A. S. Hitchcock, U. S. Dept. Agric. Pl. Ind. Bull. **68**: 28, 29), and the illustration of a specimen from Oregon (*loc. cit. pl. 6*) would answer almost perfectly for the Nantucket plant. This plant was in fresh flower when collected, whereas in the common meadow forms the panicles were completely dried.

AGROSTIS HYEMALIS (Walt.) B. S. P.

Trichodium laxiflorum Michx.

Common in sandy damp places and pond shores. The Nantucket grass of this composite species is clearly the plant of Michaux, whatever Walter's *Cornucopiae hyemalis* may have been. It is characterized by greatly elongated panicle-branches, slender-pedicelled, not crowded spikelets, the empty glumes narrowly acuminate, 2–2.5 mm. long; flowering scale narrow, 1.25 mm. long; basal leaves numerous, setaceous; culm leaves broader, 1–2 mm. wide.

* AGROSTIS ELATA (Pursh) Trin.

Common in sphagnum bogs and wet places. A late-flowering grass, coming into bloom in late August and September, sometimes growing in close masses and becoming conspicuous from its purple panicles.

This grass seems never to become as tall and strongly developed on Nantucket as in the sandy swamps of New Jersey and Long Island, and is often a small and flaccid quite inconspicuous bog plant. In favorable situations, however, it attains a growth

which approaches typical examples of the species, the leaves becoming 2–3 mm. wide, panicles 2–3.5 dm. in length, and spikelets 3–3.5 mm. long.

This species develops slender underground rootstocks, and the culms are often branched from near the base, characters which I have not observed in the tufted, green-panicled woodland grass, *A. perennans* (Walt.) Tuckerm. (*A. intermedia* Scribn.), to which *A. elata* has been referred as a variety.

HOLCUS LANATUS L.

Scattered all over the island; inflorescence mostly dried.

AIRA CARYOPHYLLEA L.

Widely scattered over the island and locally very common: below the "Cliff," east and west of the town; on and below the bluff at 'Sconset; sandy levels about some of the ponds on the south shore. Plants dead and dried but holding many spikelets in the silvery panicles.

DESCHAMPSIA FLEXUOSA (L.) Trin.

Very common over the moorland and dry commons and abundant in the cedar barrens on Coskaty; panicles dried.

DANTHONIA SPICATA (L.) Beauv.

Very common; culms and spikes mostly dried. Among scrub pines south of the county fair grounds, a stout, strongly tufted form was collected September 2, 1904, bearing many fresh panicles. This plant appears somewhat intermediate between *D. spicata* and *D. sericea* Nutt., the sheaths and leaves being somewhat villous and the flowering scale rather densely pilose and with slender teeth 2–3 mm. long. It seems to be precisely the grass described from Long Island by Austin in 1872, as *Danthonia Alleni*. (Bull. Torrey Club **3**: 21.)

It is frequent on Long Island and I have collected a variation of it on Mt. Desert, Maine, and on Cobble Hill, Lake Placid (apparently *D. Faxoni* Austin, Bull. Torrey Club **6**: 190. 1877). The Lake Placid specimens bore perfectly fresh panicles as late in the season as October 20, 1901, although the first heavy snow had fallen two days before.

Compared with *D. spicata* in its simplest state this stouter form appears very distinct but intermediate examples everywhere

seem to bridge the differences between them. Some of the Nantucket specimens show the slender bracts at the base of the panicle-branches just as described by Austin, but the culms are not branched except that one shows a secondary panicle starting from one of the upper nodes.

SPARTINA CYNOSUROIDES (L.) Willd.

Common, sometimes occurring far from marshland on the dry commons. At Quaise and Eatfire is found a stout form having numerous crowded spikes, sometimes as many as forty, which is suggestive of *S. polystachya* (Michx.) Ell. The record of the latter from "Eatfire and elsewhere" would therefore seem to require confirmation.

* SPARTINA JUNCEA (Michx.) Willd.

Frequent or common, usually in dry white sand back of the beaches, sometimes in cranberry bogs near the shore. Later-flowering than *S. patens*, the spikes being uniformly in fresh condition at the middle of September when those of the latter are mostly dried. Certain examples suggest intergradation with *S. patens* but the plants usually appear very distinct. *S. juncea*, although sometimes closely cespitose, often produces scattered culms or only a few together from stout running rootstocks; it becomes as large as 12 dm. high with spikes 6 cm. long. Tufted forms agree closely with type material of *S. caespitosa* Eaton, but, as a rule, have less slender, more spreading leaves and larger spikes.

SPARTINA PATENS (Ait.) Muhl.

Everywhere in salt marshes.

SPARTINA GLABRA PILOSA Merrill.

Common along shores and tidal creeks.

SPARTINA GLABRA ALTERNIFLORA (Lois.) Merrill.

Specimens referred here are scarcely more than reduced states of the last, having few slender spikes of more separated spikelets, with obscurely puberulent or glabrous scales.

PHALARIS CANARIENSIS L.

Recorded by Mrs. Owen from about the old wharves, on the authority of Doctor Swan.

Phalaris arundinacea picta was observed as a mere garden

escape straying along a fence and into a low field at the edge of the town, 1904–'07.

PHRAGMITES PHRAGMITES (L.) Karst.

A considerable growth on the southwest side of Sachacha Pond; Reed Pond; boggy spot in the Woods.

* TRIDENS FLAVA (L.) Hitchc. Rhodora 8: 210.

Tricuspis sesslerioides (Michx.) Torrey.

In an enclosed grassy lot showing sandy exposures on North Street about a quarter mile west of the Sea Cliff Inn, September, 1907. Vigorous tufts and larger groups in full flower were scattered through the lot. Probably introduced.

TRIPLASIS PURPUREA (Walt.) Chapman.

Everywhere in dry white sand on dunes and exposed places.

* **Diplachne maritima** nom. nov.

Diplachne procumbens Nash, in Britton, Man. 128. 1901, not *D. procumbens* Arech.Gram. Urug. 1894, *fide* Hitchc. U. S. Dept. Agric. Pl. Ind. Bull. 33: 17. F 1903.

Sparingly on the shores of Sachacha Pond, 1899; in considerable abundance on the sandy shore of Miacomet Pond, 1907, a reduced form, growing in small, congested, flatly prostrate tufts 1–2 dm. in diameter: culms numerous, crowded, branched 0.5–2 dm. long; panicles 3–8 cm. long, mostly included, their branches short, appressed, 1–4 cm. long; spikes 8–10-flowered, 6–8 cm. long; flowering scales 2.5–4 mm. long, much less pilose-fringed on the margins and at the base than in the more strongly developed plant from further south, the awns 1.5–3 mm. long.

* ERAGROSTIS PURSHII Schrad.

Scattered along the sandy sides of Main Street near the edge of the town in 1899; it had spread but little in 1904 and 1906 and the following year had been nearly exterminated by the paving of the street.

ERAGROSTIS MAJOR Host.

Occasionally found by street-sides in the town and infrequent in the suburbs; a single plant at 'Sconset, 1904.

* ERAGROSTIS PECTINACEA (Michx.) Steudel.

Very common. A stouter, stiffer-leaved form with more ample

and denser panicle, and sometimes larger spikelets, in white sand among the dunes and sand wastes.

ERAGROSTIS SPECTABILIS (Pursh) A. Gray.

Frequent or common in sandy places.

DISTICHLIS SPICATA (L.) Greene.

Very common in salt marshes.

DACTYLIS GLOMERATA L.

Common, mostly in and near town and about farm lands. Inflorescence completely dried.

POA ANNUA L.

Common, some fresh panicles.

POA PRATENSIS L.

Common, panicles dried.

POA TRIVIALIS L.

Mentioned in Mrs. Owen's catalogue; I did not meet with it.

POA COMPRESSA L.

Common, panicles dried.

POA SEROTINA Ehrh.

At several places along old wharves and once by a street-side in the town.

PANICULARIA CANADENSIS (Michx.) Kuntze.

Common. A very coarse, stout form is frequent, having broad, decompound panicles, the larger leaves 12 mm. wide, the stem sometimes 1 cm. thick at base.

PANICULARIA NERVATA (Willd.) Kuntze.

Frequent; past flowering.

PANICULARIA AMERICANA (Torr.) MacM.

Uncommon; at three stations south of the town; north of the town; Polpis. Few spikelets remaining.

PANICULARIA PALLIDA (Torr.) Kuntze.

Frequent or common in ponds and pools, mostly past flowering.

* **Panicularia septentrionalis** (Hitchc.) comb. nov.

Glyceria septentrionalis Hitchc. Rhodora 8: 211. 1906.

Panicularia fluitans (L.) Kuntze, of authors, not *Glyceria fluitans* (L.) R. Br.

In pools and muddy pond-holes, not common: Wauwinet; near Reed Pond; near Tristram Coffin's homestead; roadside pool west of Maxcy's Pond. At the latter station it was freshly in flower September 14, 1907, apparently a second growth, since wherever found elsewhere it had long passed the flowering stage.

PANICULARIA ACUTIFLORA (Torr.) Kuntze.

Cato's Pond, 1899, and again 1907; this pond although named on the maps was merely a pool in a low field sometimes nearly dry in summer; roadside pool near 'Sconset; recorded from Pout Ponds. In full flower.

Puccinellia fasciculata (Torr.) comb. nov.

Poa fasciculata Torr. Fl. U. S. 1: 107. 1824.

Frequent, about the borders of salt marshes. This is the common coastwise *Puccinellia* which replaces the larger-flowered *P. maritima* (Huds.) Parl., from southern New England to New Jersey. It has commonly been referred to *P. distans* (L.) Parl., a very different plant and doubtless an introduced species in our flora. True *P. distans* is decumbent at the base and has open panicles, sometimes nearly half the length of the slender culms, formed of almost capillary widely spreading or deflexed branches sometimes 12 cm. long, in clusters of 2–5 and floriferous mostly above the middle; the spikelets are not crowded and are often slender-pedicelled, the flowering scales 1.5–2 mm. long, truncate-obtuse and rather distinctly nerved, the nerves below evidently pubescent.

In *P. fasciculata*, the culms, although often geniculate below, are not decumbent but stiffly ascending or erect, the exserted part longer than in *P. distans* and sensibly stouter and stiffer, the panicles much smaller and narrower, sometimes almost spike-like, formed of appressed or ascending stiff branches mostly single or in pairs and floriferous from near the base, the spikelets crowded, sessile or stipitate, the flowering scales 2–2.5 mm. long, acutish or obtuse, more coriaceous than in *P. distans* and less distinctly nerved, the base of the nerves glabrous or glabrate.

FESTUCA OCTOFLORA Walt.

'Sconset, along the top of the low bluff south of the settle-

ment, Aug. 30, 1904, plants dried up but with some spikelets persisting. Recorded from between 'Sconset and Sachacha.

FESTUCA MYUROS L.

Common along the railroad and in adjoining sandy fields near the town, 1906; one station near 'Sconset, 1904; plants completely dried up but many spikelets remaining.

* FESTUCA CAPILLATA Lam.

Sandy commons and pastures in the town region and on the south side of the island, stems and panicles dried but basal leaves still green.

FESTUCA OVINA L.

My collections of Nantucket plants include no specimens of true *Festuca ovina* nor have I now any quite certain recollections of having met with it. My notes, however, refer to it as having been found with spikelets nearly gone on the south pasture and in the town region. It is recorded by Mrs. Owen and is probably common.

* FESTUCA RUBRA L.

Under the currently accepted view as to what constitutes *Festuca rubra* L. in this country it is necessary to place under this name two Nantucket grasses which are quite probably distinct species. The less common one is that to which the name more properly applies, judging by comparison with presumably authentic examples of the European plant. It is a low, rather stiff grass, conspicuously blue-glaucous throughout and, although forming close tufts, develops pronounced stolons, usually short and assurgent or declined-upcurved, but sometimes more slender and 10–15 cm. in length; the basal leaves are numerous and very firm, often stiffly curved, strongly involute, 1–2 dm. long, their lower sheaths densely short-pubescent often with reflexed hairs and usually much tinged with reddish-purple; the culms are 2.5–4 dm. high, bearing panicles 5–8 cm. long, the lower branches often stiffly spreading; flowering scales scabrellous, 4.5–6 mm. long, bearing delicate awns 1–2 mm. in length. This grass was found at several widely separated localities in sandy places near the shore. It is closely matched by specimens from Nova Scotia collected by Howe & Lang, which bear labels corrected from *F. ovina* to *F.*

rubra; *no. 1568*, Halifax Harbor, Sept. 2–6, 1901, herb. N. Y. Bot. Garden, may be especially cited.

The other grass here discussed is found on the plains and commons and even far out on the moorland, where it is often to be seen rising among masses of bearberry and other low-growing plants of sandy soils. It also occurs in more strongly developed form on the borders of salt marshes. It is of either tufted or scattered habit, but possesses the character of extra-vaginal offshoots, held to be determinative of *F. rubra* among our eastern species. This character, however, is often only obscurely developed and usually takes the form of short, suberect offshoots or innovations, rather than well-defined stolons. In its commonest form, it is a very slender glaucescent grass 4–5 dm. high, the leaves of the shoots erectly clustered about the culms, very narrow and involute, 2–3 dm. long, their lower sheaths puberulent, the basal ones membranous, brownish, and distinctly veined, not broadened, pale and closely massed together as in *F. ovina*; but the flowering scales are 4.5–6 mm. long, subterete, short-awned, and often glabrous and shining, though sometimes slightly scabrellous.

Stouter forms become 6–7.5 dm. tall, with broader, less involute leaves and more open, longer-branched panicle sometimes 15 cm. long, the flowering scales 5.5–7.5 mm. in length, the empty glumes proportionately large. This grass has been frequently determined as *F. ovina duriuscula* (L.) Hack., from which it is altogether distinct. It is the *F. duriuscula* L. of Torrey's Flora of New York and is a characteristic coastwise species of Long Island and New Jersey. I am strongly of the opinion that it is a native grass distinct from true *F. rubra*. When observed on Nantucket both of these grasses were well past maturity, making impossible a thorough study in the field.

FESTUCA PRATENSIS Huds.

Streets and grassy lots in the town and in outlying fields. Probably more generally distributed, but not readily noticeable late in the season after its spikelets have fallen. *Festuca elatior* L. was not observed.

* BROMUS TECTORUM L.

A few plants on the sandy border of Mill Street not far from

the old mill, Sept. 16, 1907, some fresh panicles remaining; plants small, apparently a second growth.

BROMUS STERILIS L.

Mrs. Owen in her catalogue says that fine specimens of this grass were found near the windmill by Judge Churchill in 1886, and by herself on Fair Street the following year. It is emphasized that the grass intended is true *B. sterilis* as distinguished from *B. tectorum* which, it is said, had not at that time reached the island.

BROMUS RACEMOSUS L.

On West Center Street, Sept., 1904, a few small plants bearing fresh panicles; also on street-side in the south part of the town.

BROMUS HORDACEUS L.

Sandy field by the railroad near the town, Aug. 6, 1906, many completely dried plants; also on Mill Street with *B. tectorum*, some small, apparently second growth plants bearing fresh panicles; Shawkemo.

* BROMUS SECALINUS L.

Roadside south of the town, a single erect but dried-up culm and panicle, Aug. 5, 1906.

LOLIUM ITALICUM A. Br.

Sparingly by roadside north of the town, Aug. 4, 1906; clover field south of the town, Sept., 1907.

Lolium perenne L., as given in Mrs. Owen's list, may perhaps have referred to *L. italicum*, which had not been recognized in our flora at that time.

AGROPYRON REPENS (L.) Beauv.

Common in several of its forms, sometimes with green spikes but mostly past the flowering stage.

* AGROPYRON REPENS LITTOREUM Anders.

Sand dunes on the north shore. The plant here in view agrees closely with Scribner's description of *littoreum* in U. S. Dept. Agric. Div. Agrost. Bull. **4**: 36. It is markedly different from the abundant grass commonly assumed to be typical *repens*, but intermediate examples seem to obliterate all sharp lines of demarcation.

HORDEUM VULGARE L.

Occasionally persistent in old fields.

* **Elymus halophilus** sp. nov.

More or less glaucous, purplish-tinged, slender, erect, sometimes slightly ascending at base, after forming loose tufts, 4–7 dm. high; leaves narrow, firm, erect, those of the culm mostly 5–7, the lowest very narrow, smooth and glabrous, or slightly hairy on the upper surface near the base, narrowly attenuate, involute on the margins or throughout when dry, 2–5 mm. wide, mostly 10–15 cm. long; ligule very short; basal leaves erect, when involute appearing almost setaceous, becoming over 15 cm. long; spike erect, slender-peduncled, 4–9 cm. long, often under 1 cm. thick, the peduncles usually exserted 5–15 cm.; empty glumes 7–10 mm. or less in length, 1–1.5 mm. wide, tapering into slender rough awns of about equal length, minutely scabrous on the prominent ribs; flowering scales 6–7 mm. long, 1–1.25 mm. wide, minutely scabrellous all over, conspicuously nerved only towards the apex, tapering into slender rough awns often 1.5 cm. long.

In abundance in a salt marsh on Eel Point; also on Little Neck and sparingly near Acquidness Point.

Salt marshes and shores along the coast from Maine to New Jersey and doubtless further south. Common on Long Island. Type from Acquidness Point, Nantucket, Sept. 11, 1907, in herb. N. Y. Bot. Garden.

Differs from *Elymus virginicus* and *E. hirsutiglumis* Scribn. & Sm. in much smaller size, fewer, shorter, narrower and firmer leaves, their sheaths not inflated, smaller, more loosely flowered spike, usually glaucous and strongly purplish-tinged, shorter and more tapering flowering glumes bearing much longer, stiffer awns, scabrellous and long-awned flower-scales.

The genus Ernodea Swartz : a study of species and races*

NATHANIEL LORD BRITTON

This genus of Rubiaceae was established by Swartz† on a single species, *E. littoralis* Sw., from the island of Jamaica. It has recently been regarded as monotypic, consisting only of the type species, which is widely distributed in the Caribbean region, in Jamaica, Florida, the Bahamas, and from Santo Domingo to Guadeloupe. I do not find the genus reported from Cuba, though it almost certainly exists there and further exploration will probably reveal it. Attempts have been made to refer to *Ernodea* plants now relegated to the genus *Putoria* of the Old World and to *Isidorea* of the West Indies.

In 1905 Dr. Small characterized *Ernodea angusta*‡ from pinelands in southern Florida, and in the same year I described *Ernodea Cokeri*§ found among the collections made by Professor Coker on Abaco Island during the Bahamian exploration organized by the Geographical Society of Baltimore. The Bahamian explorations conducted by the New York Botanical Garden and the Field Museum of Natural History have revealed the existence in the Bahamas of several additional species with apparently numerous races, the genus evidently having its greatest development in these islands. These explorations have afforded convenient opportunity for field study of the plants.

The shrubs form colonies sometimes of large size, spreading from underground parts so as to clothe densely the sand or rocks on which they grow. So far as our observation goes, they are confined to limestone rocks or limestone sand. That mutation takes place freely is indicated by the fact that in the Bahamas, at least, one colony will often differ from another near by in some

---

* This treatment of a genus will serve to illustrate the propositions advanced by the writer in the symposium on "Aspects of the Species Question," at the meeting of the Botanical Society of America, Chicago, January, 1908.

† Prodr. 29. 1788.

‡ Bull. N. Y. Bot. Gard. 3 : 438.

§ In Shattuck, The Bahama Islands, 264, Botany by W. C. Coker.

minor character, such as leaf-form, tint of the corolla, prostrate or bushy habit. That such small characters are transmittable by seed is also evidenced by plants with identical features forming colonies at some distance from each other, and too far apart to have been produced by underground connection. The small fleshy yellow fruits of these plants are probably freely distributed by birds.

The numerous specimens now in the herbarium of the New York Botanical Garden seem to me to fall into six species, composed of a considerable number of races. Characters taken as specific are indicated by the following key:

Calyx-lobes varying from nearly as long as the fruit to longer.
  Leaves lanceolate to oblong, oblanceolate or oblong-lanceolate, 5–10 mm. wide.
    Corolla white to pink; leaves relatively broad; plant mostly of coasts. 1. *E. littoralis.*
    Corolla red to scarlet; leaves relatively narrow; plant mostly of pine-lands. 2. *E. angusta.*
  Leaves narrowly linear, 1–3 mm. wide. 3. *E. Cokeri.*
Calyx-lobes much shorter than the fruit.
  Leaves oblong-lanceolate, 6–8 mm. wide. 4. *E. Millspaughii.*
  Leaves narrowly linear to linear-oblanceolate, 1–3 mm. wide.
    Leaves bristle-tipped; calyx-lobes half as long as the fruit. 5. *E. Taylori.*
    Leaves merely mucronate; calyx-lobes one third as long as the fruit. 6. *E. Nashii.*

1. ERNODEA LITTORALIS Sw. Prodr. 29. 1788

The first mention and illustration of this type species of the genus was by Sir Hans Sloane in his Natural History of Jamaica, where he denominated it "Thymelaea humilior foliis acutis atrovirentibus" and illustrated it on his plate 189, figs. 1 and 2. By Patrick Browne, in History of Jamaica 140, it was referred to *Knoxia*, an East Indian genus established by Linnaeus in 1753. Jamaica is therefore the type locality of the species. I observed this plant, in company with Mr. William Harris, in September, 1907, at two points on the southern coast of Jamaica, where it grows prostrate on limestone rocks and sand. It has narrowly oblong to oblong-lanceolate entire sharp-pointed leaves, 4–8 mm. wide, the subulate stipules about 1.5 mm. long; the linear-lanceolate calyx-lobes are here just about as long as the fruit, but they evidently vary from

somewhat shorter to somewhat longer. The distribution of this typical race is illustrated by the specimens cited as follows:

JAMAICA: Pedro Bluff (*Britton 1247; Harris 9719*); coastal rocks, near Black River (*Britton 1365*); rocky hillside, Great Goat Island (*Britton 1884*).

FLORIDA: Key West (*Blodgett*); Sarasota Keys (*Garber*); Indian River (*Curtiss 1117*); Sugar Loaf Key (*Follard, Collins, & Morris 54*); Longboat Key (*Tracy 6752, 7496*); Miami (*Small & Nash 27*); Bull Key (*Small 629*); Virginia Key (*Britton 109*); beach opposite Miami (*Small 2152*); pinelands, Miami (*Britton 462*).

BAHAMAS: Great Bahama (*Britton & Millspaugh 2373, 2707*); Abaco (*Brace 1806; E. angusta* Small?); Andros (*Brace 6770*); Harbour Island (*Mrs. Britton 6380, 6414*); Eleuthera (*Britton & Millspaugh 5410*); Crooked Island (*Brace 4606, 4624*); Long Cay (*Brace 4069*); Acklin's Island (*Brace 4282*); Rum Cay (*Brace 3943*); Green Cay (*Coker 244*); Mariguana (*P. Wilson 7456*); Great Ragged Island (*P. Wilson 7880*).

SANTO DOMINGO: (*Wright, Parry, & Brummel 220*).

PORTO RICO: Sand dunes, Santurce (*Heller 64; Millspaugh 266*); Mayagüez to Joyua (*Underwood & Griggs 185*); Island of Culebra (*Britton & Wheeler 205*).

ST. CROIX: (*Hansen 155*).

GUADELOUPE: Calcareous rocks, Desirade (*Duss 2772*).

Race 1. Leaves narrowly linear-oblong, glandular-serrulate; twigs glabrous; calyx-lobes as long as the fruit or a little longer.

BAHAMAS: Cockburn Town, Watling's Island (*Britton & Millspaugh 6075*, type; *P. Wilson 7210*).

Race 2. Leaves broadly linear-oblong, 8–10 mm. wide, glandular-serrulate; calyx-lobes a little longer than the fruit. Shrub 1.3–1.6 m. high!

BAHAMAS: Miner's Tent to Balsam Hill, Inagua (*Nash & Taylor 1274*). This is the most vigorous development of the genus that has come to my attention, and has claims for recognition as a species.

Race 3. Leaves essentially of the typical race, but glandular-serrulate; twigs densely glandular-puberulent; calyx-lobes long.

BAHAMAS: Blakesville, Inagua (*Nash & Taylor 1105*). The specimen is in flower.

Race 4. Leaves large, lanceolate or oblong-lanceolate, taper-

ing upward from below the middle, 6 cm. long, 1 cm. wide, entire-margined ; calyx-lobes a little longer than the fruit.

BAHAMAS: Swamp, road to Stopper Hill, Crooked Island (*Brace 4807*). This is the only specimen known to me to grow in swampy ground.

Race 5. Leaves relatively thin, linear-oblong, entire-margined ; calyx-lobes very narrow, 1.5 times as long as the fruit.

ST. CROIX: Pinetree Bay (*A. E. Ricksecker 333*, type).

PORTO RICO: Limestone hills three miles west of Ponce (*Heller 6243*).

There is no doubt that if plants here included in the typical race could be grown from seed, side by side, additional races to those here defined would be indicated by differences which herbarium specimens do not exhibit.

The typical race usually grows within the reach of ocean spray, accompanied by distinctively halophytic plants.

2. ERNODEA ANGUSTA Small, Bull. N. Y. Bot. Gard. 3: 438. 1905

This pine-barren plant of southern Florida was proposed by Dr. Small as a species distinct from *E. littoralis* on account of its smaller flowers and narrower leaves. He described the flowers as whitish ; they are pink or red, though the albino condition may, likely enough, exist. My observations do not bear out the original observation that the flowers are necessarily smaller than those of *E. littoralis*, and plants of that species sometimes bear leaves as narrow as those of Dr. Small's type specimen, while red-flowered plants existing on the northern Bahama islands, while mostly narrow-leaved, like the type, sometimes bear broader leaves. It is an interesting circumstance that plants conforming to the type in both characters occur throughout the area of *Pinus caribaea* Morelet in South Florida and the northern Bahamas, almost though not quite to the exclusion of typical *E. littoralis*, as though the pine-land condition suited *E. angusta*, considered either as a species or as a race of *E. littoralis ;* this is an ecological feature of extreme interest, especially as there are a number of other species or races which give character to these pine-lands. *E. angusta* apparently extends to the coasts where pine-lands are near by, or where

pine trees formerly grew. The following specimens have been examined :

FLORIDA : Between Cutler and Longview Camp (*Small 870*) ; below Cutler (*S. H. Richmond*) ; beach opposite Miami (*Small 2157*) ; near Silver Palm School (*Small 2260*) ; near Long Prairie (*Britton 191*) ; Boca Grande Key, Marquesas Group (*Lansing 2276 ; E. littoralis ?*).

BAHAMAS : New Providence (*Northrop 102 ; Cooper 58 ; Coker 63 ; Britton & Millspaugh 2099*) ; Andros (*Brace 4958, 5120, 5167, 5319, 6867, 6993, 7084*).

Race 1. Leaves relatively twice as wide as in the typical race ; corolla bright-scarlet. This inhabits Garden Cay at the western end of the Great Bahama Island (*Brace 3662*) ; it may be better regarded as a scarlet-flowered race of *E. littoralis*.

3. ERNODEA COKERI Britton ; Coker in Shattuck, The Bahama Islands 264. 1905

Occurring at the northern and northeastern range of the genus, this species exhibits the narrowest leaves of any, these being mostly only 1.5 mm. wide or less. So far as known it is confined to Abaco and the Great Bahama, growing in pine-lands and in scrub-lands where pines evidently formerly existed. Its flowers are apparently red or pink. I have seen the plant growing on the Great Bahama Island, but not in bloom ; its aspect and habit are very characteristic there, it forming a trailing vine, a meter long or more.

BAHAMAS : Abaco (*Coker 564 ; Brace 1805, 1821*) ; Great Bahama (*Britton & Millspaugh 2370*).

Race 1. Leaves twice as wide as typical, approaching in size and form those of *E. angusta*. On sand dunes, Barnett's Point, Great Bahama (*Britton & Millspaugh 2681*).

4. **Ernodea Millspaughii** sp. nov.

A shrub, 6–12 dm. high, the twigs and leaves glabrous. Leaves oblong-oblanceolate, sharply pointed, 2–3 cm. long, 5–8 mm. wide, similar to those of *E. littoralis*, the short broad stipules cuspidate ; flowering calyx obovoid, about 3 mm. long, the triangular lobes only one fifth to one fourth as long as the ovary ; corolla white, 1 cm. long, its lobes about one half as long as the tube ; fruit nearly oval, 5 mm. long, the calyx-lobes triangular-lanceolate, 1.5–2 mm. long.

BAHAMAS: Sand dunes, Clarence Town, Long Island, March 16–19, 1907 (*Britton & Millspaugh 6249*, type); Grand Turk (*Nash & Taylor 3801*). The Grand Turk specimens differ from the type in having calyx-lobes a little longer and narrower and approach the plant of Great Ragged Island (*P. Wilson 7880*), *E. littoralis*. This might be regarded as a race of *E. littoralis* with short calyx-lobes.

5. **Ernodea Taylori** sp. nov.

Spreading, with long slender branches, glabrous. Leaves narrowly linear, stiff, 1.5–2.5 cm. long, 1.5–2 mm. wide, revolute-margined, spinulose-tipped, the stipules triangular-subulate; flowers not seen; fruit golden-yellow, oval, 5 mm. long, the calyx-lobes narrowly linear, 2 mm. long.

BAHAMAS: In white land, Tenados, Inagua, Oct. 14, 1904 (*Nash & Taylor 1024*).

The foliage resembles that of *E. Cokeri*, but the calyx is altogether different.

6. **Ernodea Nashii** sp. nov.

Prostrate, glabrous throughout, the branches 6 dm. long or more, the branchlets erect or ascending, 0.5–2 dm. high, the twigs very densely clothed with leaves. Leaves linear-oblanceolate, leathery in texture, 2–2.5 cm. long, 2–3 mm. wide, mucronulate; flowering calyx 4.5 mm. long, its lobes acute, 1.5 mm. long; corolla 1.5 cm. long, its lobes white within, brown without, about one third as long as the tube; fruit ovoid-oval, 5 mm. long, the persistent acute calyx-lobes 1.5 mm. long.

BAHAMAS: Little Inagua, Moujean Harbor (*Nash & Taylor 1193*, type); west end of Little Inagua (*P. Wilson 7782*).

The development of the embryo-sac and embryo of Potamogeton lucens

MELVILLE THURSTON COOK

(WITH PLATES 9 AND 10)

The purpose of this study was to compare the development of the embryo-sac and embryo of this plant with those of other well-recognized monocotyledonous plants and with the Nymphaeaceae; also for the purpose of comparison with Holferty's (9) paper on *Potamogeton natans* and Wiegand's (14) paper on *P. foliosus*. This became especially important since the two authors differed so widely in their conclusions concerning the development of the embryo-sac. My own results are somewhat different from either and it has been possible to carry the study of the embryo further. It, therefore, seems advisable to publish the results at this time.

The material for this study was collected in a large lagoon near San Antonio de los Baños in the Province of Havana, Cuba. It was killed and fixed in the following preparations:

1. Chromo-acetic solution,
   Water . . . . . 99 c.c.
   Glacial acetic acid . . . . . .3 c.c.
   Chromic acid. . . . . .7 gram.
2. Picro-acetic solution,
   (*a*) Saturated aqueous solution of picric acid . . . . . 99 c.c.
   Glacial acetic acid . . . . . 1 c.c.
   (*b*) Saturated 70 per cent. alcoholic solution of picric acid . . . 99 c.c.
   Glacial acetic acid . . . . . 1 c.c.
3. Sulphuro-acetic solution,
   (*a*) Saturated aqueous solution of picric acid . . . . . 98 c.c.
   Sulphuric acid . . . . . 2 c.c.
   (*b*) Saturated 70 per cent. alcoholic solution of picric acid. . . 98 c.c.
   Sulphuric acid . . . . . 2 c.c.

All these preparations were quite satisfactory but the picro-acetic preparations were the best and the aqueous solution better than the alcoholic.

The greater part of the work was done in the laboratory of the New York Botanical Garden and specimens of the plant have been deposited in the herbarium of that institution.

I was unable to follow the origin and development of the archesporium satisfactorily and therefore begin my discussion with the functional megaspore, which is very conspicuous and located some four to six layers of cells below the surface of the ovule (*figure 1*). It grows rapidly and develops into the normal eight-nucleate sac (*figures 2, 3, 4*). In the four-nucleate stage (*figure 3*) the sac is considerably larger at the synergid than at the antipodal end and agrees quite well in shape with Wiegand's figure 19. The two nuclei of the synergid end are placed at right angles to the long axis of the sac and ovule, while the two in the antipodal region are placed in the same direction as the long axis. The nuclei of the synergid end divide a little in advance of those of the antipodal end. A number of preparations in this stage were examined but in no case was there a common membrane around the cells in the synergid end previous to fertilization as described by Wiegand. In the eight-nucleate stage the nuclei are perfectly clear and well defined (*figure 4*). The two synergids and egg are quite large, and each is surrounded by a delicate membrane. The three antipodals are relatively large and have well-defined walls. They were never observed in a well-defined pocket as described and figured by Wiegand and by Holferty. The polar nuclei are somewhat smaller than in most plants which the writer has examined. They unite about the middle of the sac in the usual manner (*figures 4, 4a*). The fertilization of the egg was not observed but the union of the two polar and one male nucleus was observed once (*figure 4b*). Other preparations apparently showed the same thing but upon this point the writer could not be positive.

After a union of the two polar nuclei the newly formed endosperm nucleus increases in size rapidly and passes into the antipodal end of the sac (*figures 5, 6*). In the meantime the antipodal cells disintegrate and disappear entirely (*figure 6*), the young unicellular embryo (or pro-embryo) increases in size rapidly while the synergids gradually disintegrate (*figures 5, 6, 7, 8, 9*). At this time the general appearance of the sac is strikingly similar to that shown in Wiegand's figure 20.

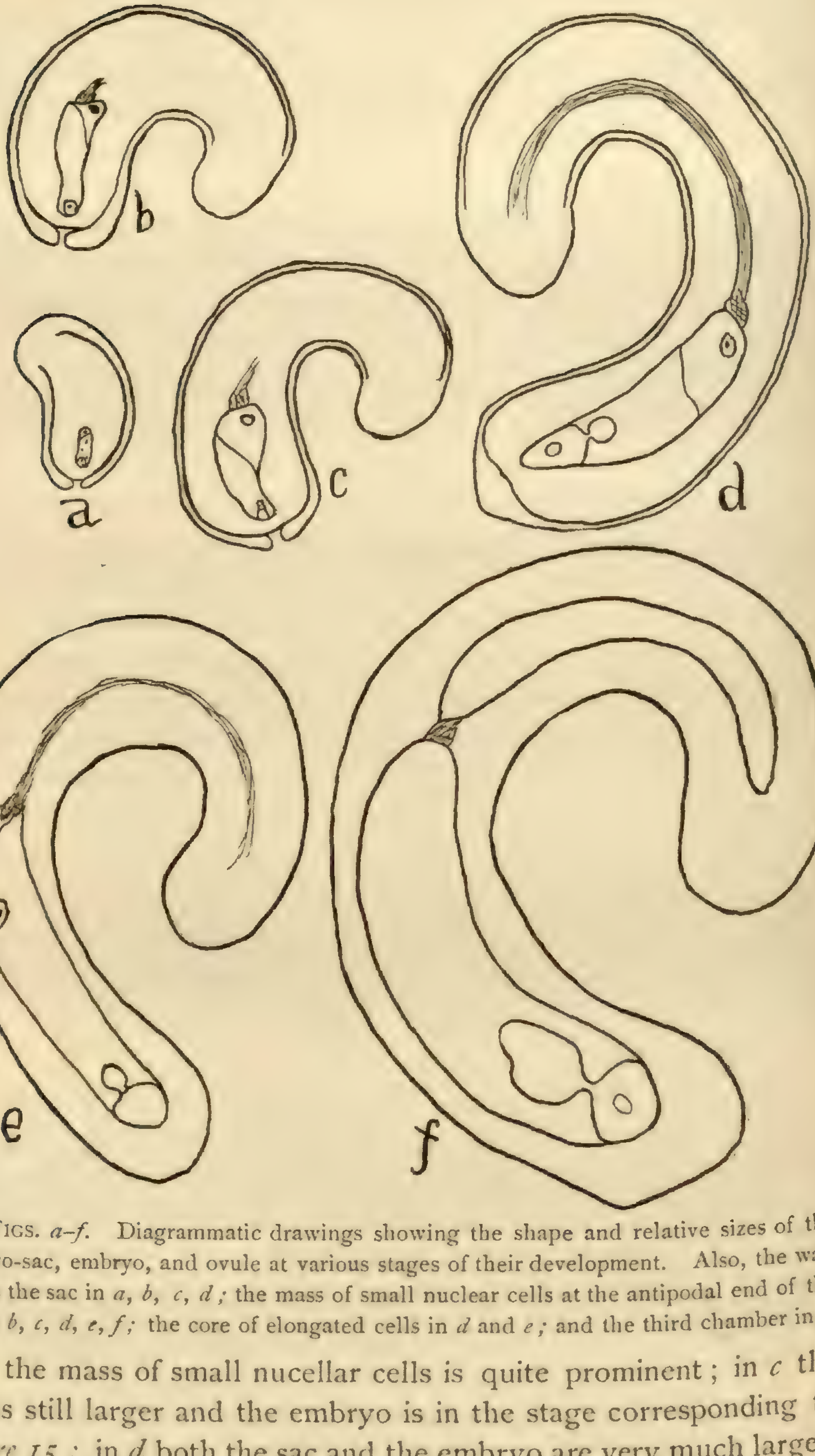
The primary endosperm nucleus now divides into two daughter-cells which are immediately separated by the formation of a wall across the sac (*figure 7*). The daughter-nucleus on the synergid

side of the wall divides rapidly and produces an abundant endosperm, which is usually non-cellular and parietal in character (*figure 12*), but occasionally becomes cellular and fills the entire sac (*figure 13*). The sac increases in size, especially in its long axis, the nucellar tissue bounding it gradually undergoing disintegration. At the same time the daughter-nucleus in the antipodal end, which, in accordance with my second paper on Nymphaeaceae, I shall designate as the "nucleus of the nucellar tube," increases rapidly in size and moves farther and farther from the partition-wall (*figures 9, 10, 11*, and *text-figures a–f*). This increase in size and activity continues until the embryo has reached the age indicated in *figure 22*, after which it undergoes disintegration (*figure 11*) and gradually disappears. Some time previous to this the partition separating the two ends of the sac has also disappeared.

At about the time of the disintegration of the large nucleus of the nucellar tube the endosperm is very conspicuous, consisting of large spindle-shaped cells (*figure 12*) which stain deeply and frequently contain several nucleoli and evidently are very active. In most cases they are without cell-walls and form a parietal layer one to three cells thick lining the sac, but occasionally they have cell-walls and fill the entire sac (*figure 13*). With the breaking down of the wall across the sac and disintegration of the large cell of the nucellar tube the endosperm extends into the antipodal end of the sac. Coördinate with the activity of the endosperm there is a corresponding disintegration of the nucellar cells bounding the sac.

Soon after the division of the primary endosperm-nucleus a mass of small nucellar cells may be distinguished at the antipodal end of the sac (*figure 14* and *text-figures b–f*) and from this mass of cells there extends to the chalazal region a core of elongated cells which eventually disintegrate, leaving a large third chamber which is separated from the true embryo-sac. It is probable that this sac finally becomes a part of the embryo-sac and is occupied by the cotyledonary end of the embryo.

The gradual increase in size and the modifications in the shape of the ovule and sac are shown in *text-figures a* to *f*. *Figure a* corresponds to *figure 9*; in *figure b* the sac is somewhat larger



FIGS. *a–f.* Diagrammatic drawings showing the shape and relative sizes of the embryo-sac, embryo, and ovule at various stages of their development. Also, the wall across the sac in *a*, *b*, *c*, *d*; the mass of small nuclear cells at the antipodal end of the sac in *b*, *c*, *d*, *e*, *f*; the core of elongated cells in *d* and *e*; and the third chamber in *f*.

and the mass of small nucellar cells is quite prominent; in *c* the sac is still larger and the embryo is in the stage corresponding to *figure 15*; in *d* both the sac and the embryo are very much larger, the embryo at this time being about the age indicated in *figure 21*;

in *e* the sac has increased somewhat in size, the partition-wall has disappeared, the large tube-nucleus has reached its maximum in both size and activity and the embryo is about the same age as in *figure 22 ;* in *f* the sac is very much enlarged and the new chamber at the chalazal end of the sac has developed, the embryo at this time being about the same age as in *figure 24*.

The formation of a wall across the embryo-sac separating the two daughter-nuclei formed by the first division of the primary endosperm-nucleus has been observed in many plants. It occurs in both dicotyledonous and monocotyledonous families but further studies will probably show marked differences in its behavior in these two main groups of angiosperms.

The embryo-sac of *Alisma Plantago* (now known as *Alisma Plantago-aquatica*) as described by Schaffner (12) corresponds in most respects to that of *Potamogeton lucens*, although he did not observe the formation of a wall after the division of the primary nucleus. However, in his later work on *Sagittaria variabilis* (13), (now known as *Sagittaria latifolia*) he describes a sac which corresponds remarkably well to that of *P. lucens*, with the exception that the antipodals are more persistent and that the nucleus of the nucellar tube has a tendency to fragment.* It is possible that further study of *Alisma Plantago-aquatica* will also show the formation of a wall across the sac. My own studies on Nymphaeaceae show the same formation of a wall across the sac separating the two daughter-nuclei of the primary endosperm-nucleus, the daughter-nucleus in the synergid end of the sac giving rise to the endosperm and the daughter-nucleus in the antipodal end passing into a tube or saccular structure (differing somewhat in different genera) formed by disintegration of the nucellar tissue. The behavior of this nucleus of the nucellar tube of the genus *Nymphaea* was more nearly like that of *Potamogeton lucens* than that of any other genus. In fact the general appearance, history, and behavior of these structures in *P. lucens* and in *Nymphaea* are strikingly similar. Johnson (10) describes a similar condition in *Saururus cernuus*, which is very similar to that described by me for

* Schaffner's studies on *S. variabilis* were verified by my own studies on *S. lancifolia* with the exception that I found the antipodals of *S. lancifolia* not so persistent as in *S. variabilis*.

Castalia ampla in my paper on Cuban Nymphaeaceae (5). Coker (3) describes a somewhat similar condition for certain of the Pontederiaceae except that he describes the daughter-nucleus in the antipodal end of the sac as going through a series of divisions to form an endosperm. Campbell (1) reports the presence of a large cell in the antipodal end of the embryo-sacs of *Naias flexilis* and *Zannichellia palustris* but did not determine its origin in either case. However, he states that this cell does not divide, but that in *Zannichellia palustris* "it looked as if it were undergoing disintegration," and that in both plants the endosperm arises in the synergid end of the sac. Hall (8) in his studies on *Limnocharis emarginata* reports a single antipodal cell and a single polar cell which is formed in the micropylar end of the sac; this single polar cell divides and behaves in the same manner as the primary endosperm in the Nymphaeaceae, *Sagittaria*, and *Potamogeton lucens*. This embryo-sac is so remarkable in character and so unlike any other known at this time, while the behavior of the polar nucleus is so similar to the primary endosperm of the plant just referred to, that one is justified in saying that the union of the two polar nuclei may have been overlooked. Wiegand (14) in his studies of *Potamogeton foliosus* describes a peculiar seven-nucleated sac in which but three nuclei (the egg and the two synergids) are formed at the micropylar end of the sac, the polar nucleus from the antipodal end of the sac dividing and behaving similarly to the primary endosperm-nucleus in Nymphaeaceae, *Sagittaria*, and *P. lucens*. Holferty (9) in his studies of *Potamogeton natans* describes a normal eight-nucleated sac. He failed to find a wall across the sac at any stage of its history. He did not trace the development of the endosperm but reports a very large nucleus near the antipodal end of the sac, concerning which he says "Its origin could not be determined, but it seems reasonable to consider it a derivative of the primary endosperm-nucleus, and possibly the lower nucleus of the first division, as in *Sagittaria* and *Potamogeton pauciflorus*." In the light of these later studies it seems possible that Wiegand may have overlooked the formation of the eight-nucleate sac. Aside from the fact that the antipodal cells of *Potamogeton foliosus* are evidently more persistent than those in *P. lucens*, his figure 20 corresponds quite well with *figures 5* and *6* of this paper, his figure 21 with

my *figure 7*, his figure 23 with my *figure 8*, and his figure 24 with my *figure 9*. It is well known that there may be considerable variation between genera of the same family and also some variations between species of the same genus. This question of the variation and constancy of characters between closely related species, genera, and families is of sufficient importance to demand the attention of students of this subject.

That this large nucleus of the nucellar tube performs a very important function in the nourishment of the endosperm and embryo appears self-evident at this stage of our knowledge. The writer has previously discussed this phase of the subject in papers on Nymphaeaceae (4, 5). Its morphological significance is somewhat uncertain. In my first paper on Nymphaeaceae (4) I expressed the opinion that this might be of some importance in determining the close relationship of the Nymphaeaceae with monocotyledonous plants in the series Helobiae. The phylogenetic importance of these morphological characters was denied by Johnson (11) but since that time the family Piperaceae, on which he made his studies, has been placed by the taxonomist as the lowest of the dicotyledonous families. The writer believes that we do not have sufficient data to draw very definite conclusions but wishes to emphasize the importance of further studies in these families.

THE EMBRYO

The general development of the embryo is in accordance with the *Alisma* type and bears a very striking resemblance to the embryo of *Sagittaria variabilis*. The young embryo increases in size but is very slow in undergoing its first division (*figures 5, 6, 9*, and *text-figures a, b, c*). A comparison of figures indicates that the first division of the embryos of *Potamogeton foliosus* and *S. variabilis* occurs earlier than in the embryo of *P. lucens*. After the first division the basal cell grows rapidly and forms a very thick cell-wall and is very similar to the basal cell of *Sparganium*, *Zannichellia*, *Naias*, *Triglochin*, *Limnocharis*, and *Potamogeton foliosus* and *P. natans* (*figures 15, 18, 23*). It contains an abundance of protoplasm, stains deeply, and gives every evidence of great activity until the appearance of the cotyledon, when it first shows signs of disintegration.

The number of cells in acropetal succession may be six in number. When three cells are formed the apical cell divides by the formation of two longitudinal walls at right angles (*figure 15*) and this is followed by cross and longitudinal divisions of the second and third cells (*figures 16, 17, 19, 20, 21*). Thus far the formation of the embryo is in harmony with the descriptions given by Wiegand and Holferty for *P. foliosus* and *P. natans*.

The further development of the embryo shows some variations at this point, in some cases showing three well-defined segments (*figures 18, 19, 21*), while in others it showed only two, as indicated in *figure 20*. The writer is unable to say positively whether the formation of the parts is strictly in accordance with the *Alisma* type or whether there is a variation as described by Campbell (1) for *Zannichellia*, but is inclined to the former view, which is assumed to be true in the further discussion of this subject. It will be noted at this time that *figure 20* corresponds quite well to Wiegand's figure 26.

The apical cell, as previously stated, divides and eventually gives rise to the cotyledon. The second cell divides by a cross-wall; of these two daughter-cells the one next to the apical cell divides, forming a second segment from which is derived the apex of the stem. The other daughter-cell forms the third segment and part of the suspensor by which the embryo is attached to the large basal cell. From this third segment are derived the hypocotyl and the root-tip. These three segments are shown in *figures 18, 19*, and *21*. Cell *a* of *figures 18, 20*, and *21* divides transversely into cells *a* and *a'* of *figure 22*. Cell *a* of *figure 22* evidently forms in part or entirely the dermatogen of the root-tip (*figures 23, 24*), while *a'* of *figure 22* divides to form cells *a'* and *a''* of *figure 23*. Cell *a'* of *figure 23* now undergoes division to form the calyptrogen, as shown in *figure 24*, while cell *a''* becomes a part of the suspensor. Shortly after this, the plerome and periblem show indications of differentiation (*figure 24*).

As previously stated, with the appearance of the cotyledon (*figure 23*) the large vesicular basal cell of the suspensor shows signs of disintegration. The suspensor is always delicate and the embryo even in its early stages is frequently found separated from the basal cell.

SUMMARY

1. The formation of the embryo is regular and typical.

2. The primary endosperm-nucleus divides and the two daughter-nuclei are separated by a wall. The one in the synergid end of the sac gives rise to the endosperm while the one in the antipodal end grows rapidly, is very active, and moves downward into an extension of the sac formed by the disintegration of the nucellar tissue, where it finally undergoes disintegration.

3. The endosperm is conspicuous, usually parietal and nuclear, without cell-walls.

4. The embryo follows the *Alisma* type in its development.

LITERATUE

1. **Campbell, D. H.** A morphological study of *Naias* and *Zannichellia*. Proc. Calif. Acad. Sci. III. **1**: 1–62. *pl. 1-5*. 1897.

2. ——. Studies on the flower and embryo of *Sparganium*. Proc. Calif. Acad. Sci. III. **1**: 293–328. *pl. 46-48*. 1897.

3. **Coker, W. C.** The development of the seed in the Pontederiaceae. Bot. Gaz. **44**: 293–301. *pl. 23*. 1907.

4. **Cook, M. T.** Development of the embryo-sac and embryo of *Castalia odorata* and *Nymphaea advena*. Bull. Torrey Club **29**: 211–220. *pl. 12, 13*. 1902.

5. ——. The embryology of some Cuban Nymphaeaceae. Bot. Gaz. **42**: 376–392. *pl. 16–18*. 1906.

6. ——. The embryology of *Sagittaria lancifolia* L. Ohio Nat. **7**: 97–101. *pl. 8*. 1907.

7. **Coulter, J. M. & Chamberlain, C. J.** Morphology of the Angiosperms. 1903.

8. **Hall, J. G.** An embryological study of *Limnocharis emarginata*. Bot. Gaz. **33**: 214–219. *pl. 19*. 1902.

9. **Holferty, G. M.** Ovules and embryo of *Potamogeton natans*. Bot. Gaz. **31**: 339–346. *pl. 2, 3*. 1901.

10. **Johnson, D. S.** On the development of *Saururus cernuus*. Bull. Torrey Club **27**: 365–372. *pl. 23*. 1900.

11. ——. On the development of certain Piperaceae. Bot. Gaz. **34**: 321–340. *pl. 9, 10*. 1902.

12. **Schaffner, J. H.** The embryo-sac of *Alisma Plantago*. Bot. Gaz. **21**: 123–132. *pl. 9, 10*. 1896.

13. **Schaffner, J. H.** Contribution to the life history of *Sagittaria variabilis*. Bot. Gaz. **23**: 252–273. *pl. 20–26*. 1897.

14. **Wiegand, K. M.** The development of the embryo-sac in some monocotyledonous plants. Bot. Gaz. **30**: 25–47. *pl. 6, 7*. 1900.

AGRICULTURAL EXPERIMENT STATION,
NEWARK, DELAWARE.

Explanation of plates 9 and 10

Figures 1 to 13 were made with Bausch & Lomb 1-inch eye-piece and 1/12 oil-immersion objective. Figures 14 to 24 were made with same eye-piece and 1/6 objective. All have been reduced somewhat more than one half in reproduction.

FIG. 1. Functional megaspore.
FIG. 2. Two-nucleate sac.
FIG. 3. Four-nucleate sac.
FIG. 4. Eight-nucleate sac.
FIG. 4a. Complete union of the polar nuclei.
FIG. 4b. Union of polar nuclei and male nucleus.
FIG. 5. Sac soon after fertilization.
FIG. 6. Sac soon after disintegration of the antipodal cells.
FIG. 7. Sac soon after first division of the primary endosperm-nucleus.
FIG. 8. Sac soon after first division of the nucleus in the antipodal end of the sac.
FIG. 9. Sac showing increase in endosperm growth of the nucellar tube nucleus.
FIG. 10. Nucellar tube nucleus at its maximum in size and activity.
FIG. 11. Nucellar tube undergoing disintegration.
FIG. 12. Typical endosperm-cell without walls.
FIG. 13. Unusual endosperm-cell with walls.
FIG. 14. Mass of nucellar cells at the antipodal end of the embryo-sac.
FIG. 15. Young embryo after first longitudinal division of the apical cell.
FIG. 16. Young embryo slightly older than in Fig. 15.
FIG. 17. Young embryo slightly older than in Fig. 15.
FIG. 18. Young embryo, showing three segments.
FIG. 19. Young embryo, showing three segments, slightly older than in Fig. 18.
FIG. 20. Young embryo, rather unusual form.
FIG. 21. Spherical embryo, showing three segments.
FIG. 22. Spherical embryo, showing three segments, slightly older than in Fig. 21.
FIG. 23. Embryo, showing the cotyledon and also the large vesicular basal cell in first stages of disintegration.
FIG. 24. Embryo, showing differentiation of tissues.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1908)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

This Index is reprinted monthly on cards, and furnished in this form to subscribers, at the rate of one cent for each card. Selections of cards are not permitted; each subscriber must take all cards published during the term of his subscription. Correspondence relating to the card-issue should be addressed to the Treasurer of the Torrey Botanical Club.

Bacon, W. L. The discovery of *Cryptogramma Stelleri* in Maine. Rhodora **10**: 35. 12 Mr 1908.

Bailey, W. W. A true March flower. Am. Bot. **13**: 101–103. [Mr] 1908.

Bates, C. G. A drought-resistant hickory. Science II. **27**: 473, 474. 20 Mr 1908.

Bennett, C. List of Colorado trees. Plant World **11**: 66, 67. Mr 1908.

Bois, D. Les *Ribes* de la section *Robsonia*. Rev. Hort. **80**: 29–32. *f. 6–11.* 16 Ja 1908.

Bois, D. Production de bulbilles floraux chez l'*Agave Weberi*. Rev. Hort. **80**: 149, 150. *f. 47.* 1 Ap 1908.

Clapp, G. L. A quantitative study of transpiration. Bot. Gaz. **45**: 254–267. *f. 1, 2.* 14 Ap 1908.

Clark, H. W. The holophytic plankton of lakes Atitlan and Amititlan, Guatemala. Proc. Biol. Soc. Washington **21**: 91–105. 21 Mr 1908.

Includes 3 new species, *Clathrocystis robusta*, *Staurastrum Evermanni*, and *Conferva gyrans*.

Clute, W. N. The genus *Acrostichum*. Am. Bot. **13**: 97–99. [Mr] 1908. [Illust.]

Coker, W. C. & Pemberton, J. D. A new species of *Achlya*. Bot. Gaz. **45**: 194–196. *f. 1.* 12 Mr 1908.

Conard, H. S. Acres of liverworts. Plant World **11**: 64–66. Mr 1908.

Deane, W. Some teratological forms of *Trillium undulatum*. Rhodora **10**: 21–24. 12 Mr 1908.

Eaton, A. A. Nomenclatorial studies in three orchid genera. Proc. Biol. Soc. Washington **21**: 63–67. 21 Mr 1908.

Publishes 66 new combinations, 51 in *Epipactis*, 10 in *Serapias*, and 5 in *Serapiastrum*.

[Gibson, H. H.] American forest trees — 68. Western hemlock, *Tsuga heterophylla* Sargent. Hardwood Record **25**[7]: 16, 17. 25 Ja 1908. [Illust.]

[Gibson, H. H.] American forest trees — 69. Pecan, *Hicoria Pecan* Britton. Hardwood Record **25**[9]: 16, 17. 25 F 1908. [Illust.]

[Gibson, H. H.] American forest trees — 70. Osage orange, *Toxylon pomiferum*. Hardwood Record **25**[10]: 16, 17. 10 Mr 1908. [Illust.]

[Gibson, H. H.] American forest trees — 71. Ailanthus or tree of heaven, *Ailanthus glandulosa* Desf. Hardwood Record **25**[11]: 16, 17. 25 Mr 1908. [Illust.]

Greenman, J. M. The generic name *Goldmania*. Bot. Gaz. **45**: 198. 12 Mr 1908.

Goldmanella is substituted for *Goldmania* Greenman.

Griggs, R. F. On the cytology of *Synchytrium* — III. The role of the centrosome in the reconstruction of the nucleus. Ohio Nat. **8**: 277–286. *pl. 19, 20.* Mr 1908.

Hallier, H. On the origin of angiosperms. Bot. Gaz. **45**: 196–198 12 Mr 1908.

Harshberger, J. W. Taxonomic charts of the monocotyledons and the dicotyledons. Proc. Am. Phil. Soc. **46**: 313–321. *f. 1, 2.* 20 Ja 1908.

Hasselbring, H. The carbon assimilation of *Penicillium*. Bot. Gaz. **45**: 176–193. 12 Mr 1908.

Hay, G. U. Observations on weather and plants, 1907. Bull. Nat. Hist. Soc. New Brunswick **6**: 44, 45. 1908.

Hay, G. U. The fungi of New Brunswick. Bull. Nat. Hist. Soc. New Brunswick **6**: 40–43. 1908.

Holm, T. Method of hibernation and vegetative reproduction in North American species of *Stellaria*. Am. Jour. Sci. IV. **25**: 315–322. *f. 1–6.* Ap 1908.

Howe, M. A. & Wilson, P. Report on the botanical exploration of the Bahama and Caicos islands. Jour. N. Y. Bot. Gard. **9**: 41–50. *f. 9–12.* Mr 1908.

Howe, R. H. Aspects of New England lichens. Plant World **11**: 45–55. *f. 1–6.* Mr 1908.

Howe, R. H. Two additions to the lichen flora of the Blue Hills. Rhodora **10**: 35, 36. 12 Mr 1908.

Keller, R. Zur Kenntnis der Sectio *Brathys* des Genus *Hypericum*. Bull. Herb. Boiss. II. **8**: 175–191. 29 F 1908.

Includes 6 new American species.

Laney, C. C. The types of the American elm. Gard. Mag. **7**: 154–156. *f. 1–12.* Mr 1908.

Laughlin, E. E. Enchanter's nightshade. Am. Bot. **13**: 99–101. [Mr] 1908.

Lloyd, F. E. A water-storage organ in *Cuscuta*. Plant World **11**: 67, 68. Mr 1908.

Macoun, J. M. Botanical notes. Ottawa Nat. **21**: 218. 4 Mr 1908; 231. 7 Mr 1908.

Matthiesen, F. Beiträge zur Kenntnis der Podostemaceen. Bibl. Bot. **15**[68]: 1–55. *pl. 1–9.* 1908.

Includes new species in *Oenone* (2), and in *Rhyncholacis* (2).

Mottet, S. *Pavia macrostachya*. Rev. Hort. **80**: 101–104. *f. 31, 32.* 1 Mr 1908.

Pease, A. S. Preliminary lists of New England plants — XV. Addenda. Rhodora **10**: 36. 12 Mr 1908.

Rehder, A. The New England species of *Psedera*. Rhodora **10**: 24–29. 12 Mr 1908.

Robinson, B. L. Notes on the vascular plants of the northeastern United States. Rhodora **10**: 29–35. 12 Mr 1908.

Includes *Woodsia Cathcartiana* sp. nov.

Schaffner, J. H. On the origin of polar conjugation in the angiosperms. Ohio Nat. **8**: 255–258. 15 F 1908.

Shull, G. H. The pedigree–culture: its aims and methods. Plant World **11**: 21–28. F 1908: 55–64. Mr 1908.

Smith, G. D. The pear-form puff-ball. Myc. Bull. **6**: 14, 15. *f. 285, 286.* F 1908.

Smith, G. D. *Phallogaster saccatus.* Myc. Bull. **6**: 17, 18, 19. *f. 287.* Mr 1908.

Sprague, T. A. *Sinningia Regina.* Curtis Bot. Mag. IV. **4**: *pl. 8182.* Mr 1908.

Sprague, T. A. New or noteworthy plants. *Columnea magnifica.* Gard. Chron. III. **43**: 66, 67. *f. 33.* 1 F 1908.

Standley, P. C. Some *Echinocerei* from New Mexico. Bull. Torrey Club **35**: 77–88. *f. 1–5.* 9 Mr 1908.
Includes *Echinocereus neo-mexicanus* sp. nov.

Sumstine, D. R. More moulds. Myc. Bull. **6**: 9–11. *f. 282, 283.* F 1908.

Terry, W. A. A new variety of the ostrich fern. Fern Bull. **16**: 3, 4. [Mr] 1908.

Ule, E. Die Kakteen im brasilianischen Staate Bahia. Monats. Kakteenk. **18**: 17–24. 15 F 1908. [Illust.]

Ule, E. Die Pflanzenformationen des Amazonas-Gebietes—II. Pflanzengeographische Ergebnisse meiner in den Jahren 1900–1903 in Brasilien und Peru unternommenen Reisen. Bot. Jahrb. **40**: 398–432. *pl. 9–11.* 24 Ja 1908; 433–443. 3 Mr 1908.

Ule, E. Kautschukgewinnung und Kautschukhandel in Bahia. Notizbl. Königl. Bot. Gard. Berlin **5**: 1–52. *pl. 1–4.* 25 Ja 1908.

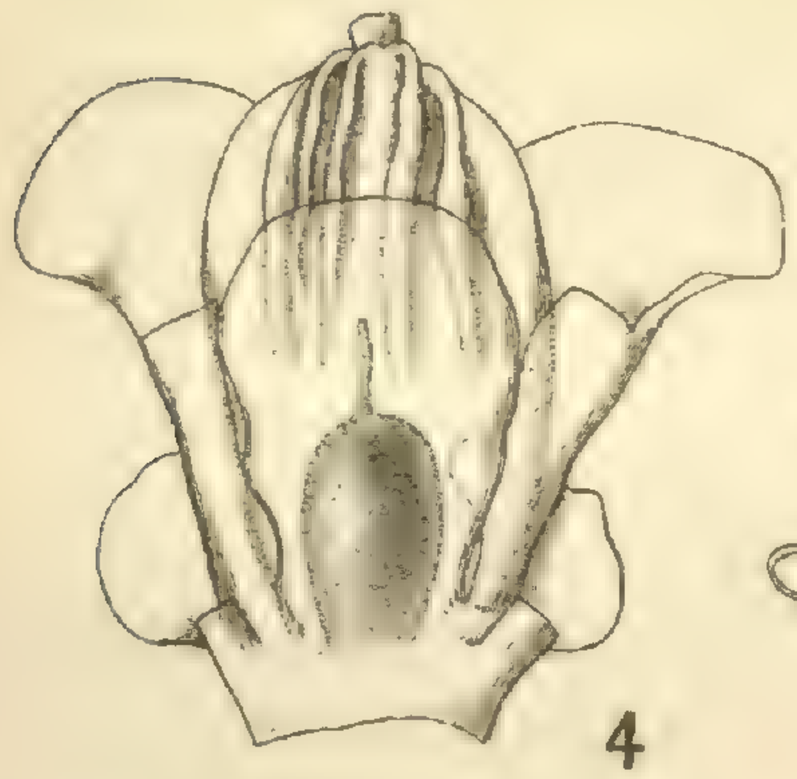
Warnstorf, C. Neue europäische und aussereuropäische Torfmoose (Schluss). Hedwigia **47**: 113–124. 3 Ja 1908.

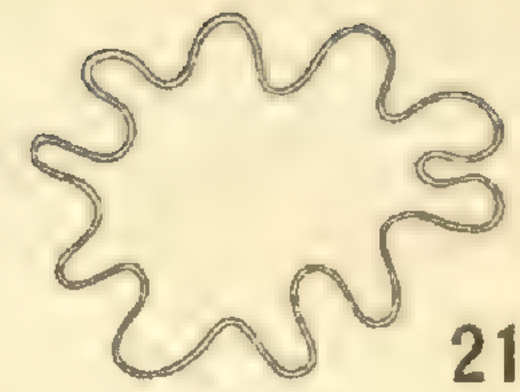
Warren, A. E. Does the botanizer need a microscope? Am. Bot. **13**: 104, 105. [Mr] 1908.

Weingart, W. *Cereus serpentinus* var. *albispinus.* Monats. Kakteenk. **18**: 30. 15 F 1908.

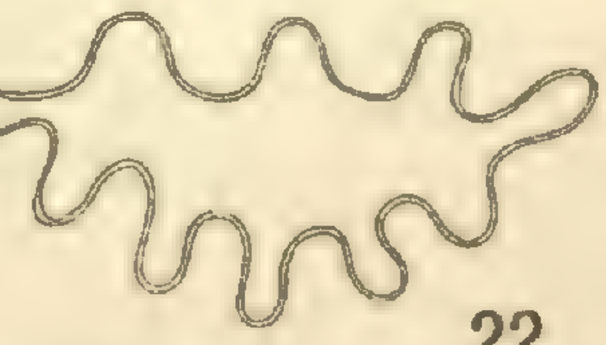
White, C. A. The phenogamous parasites. Am. Nat. **42**: 12–33. *f. 1–8.* 21 Mr 1908.

Yamanouchi, S. Spermatogenesis, oögenesis, and fertilization in *Nephrodium.* Bot. Gaz. **45**: 145–175. *pl. 6–8.* 12 Mr 1908.

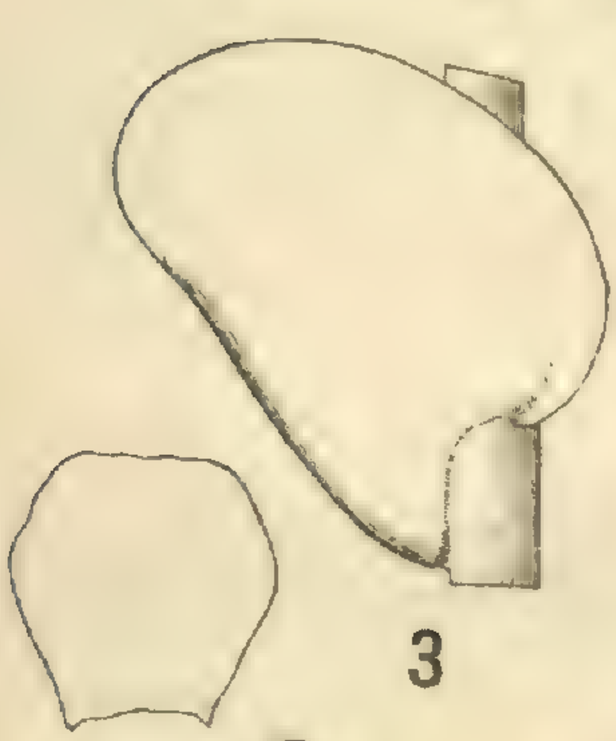

4


21

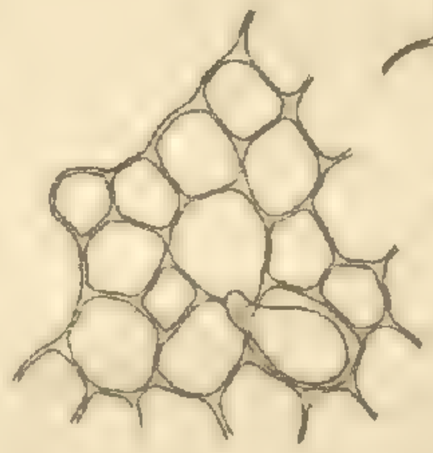
5


22

6


3

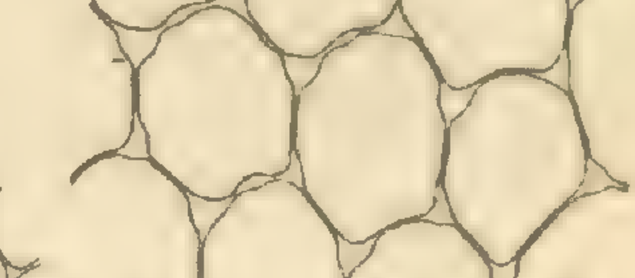
15


10

20

12

7

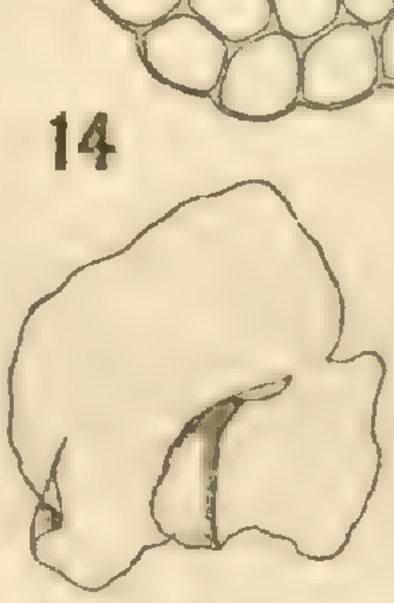

8

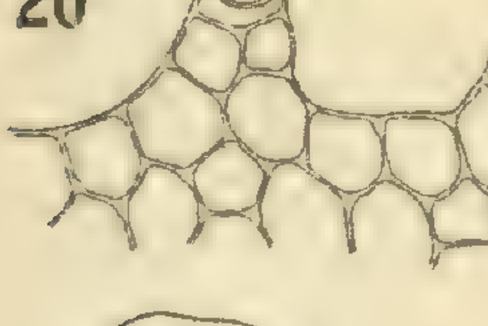
14

9

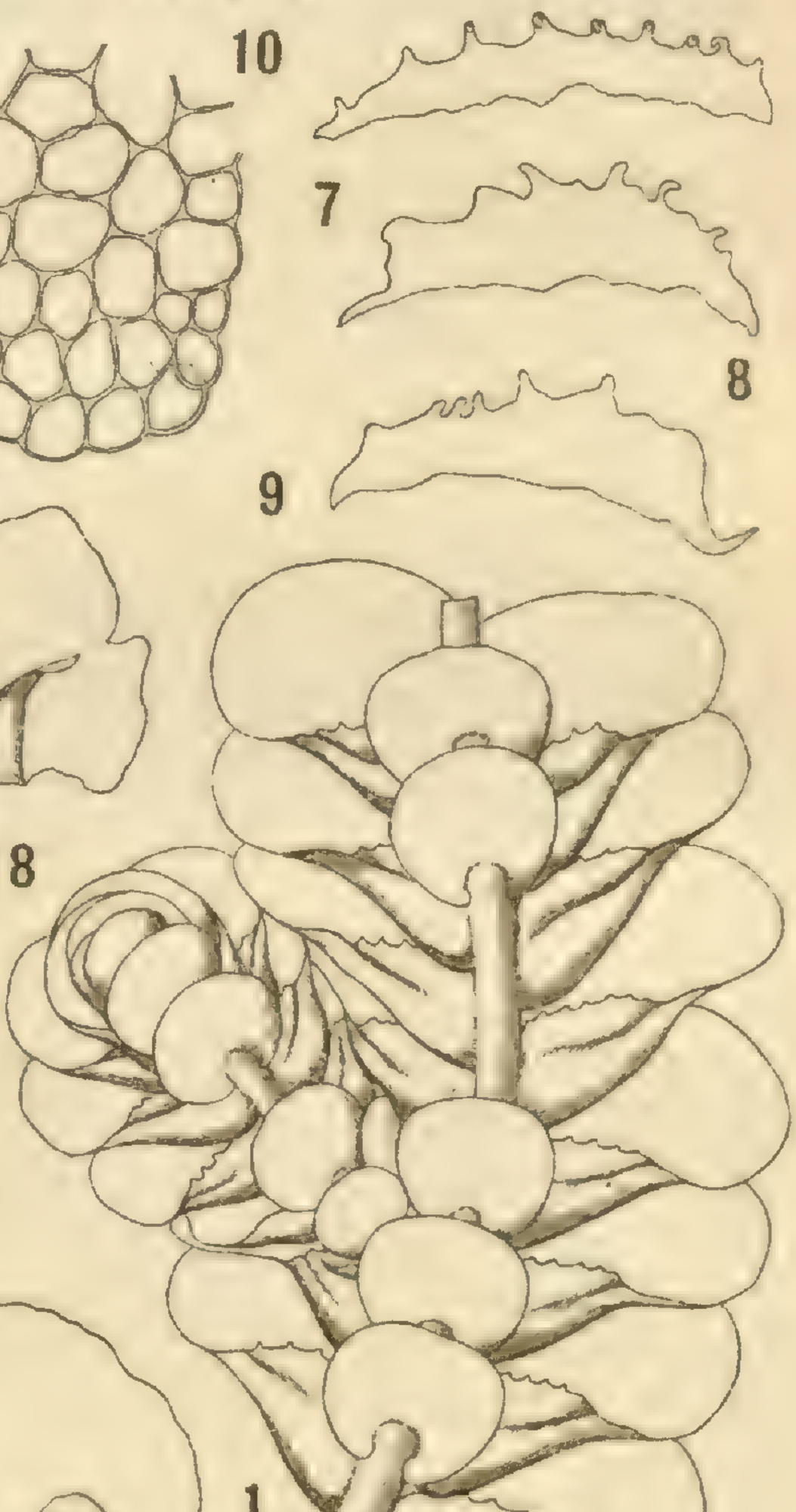
16

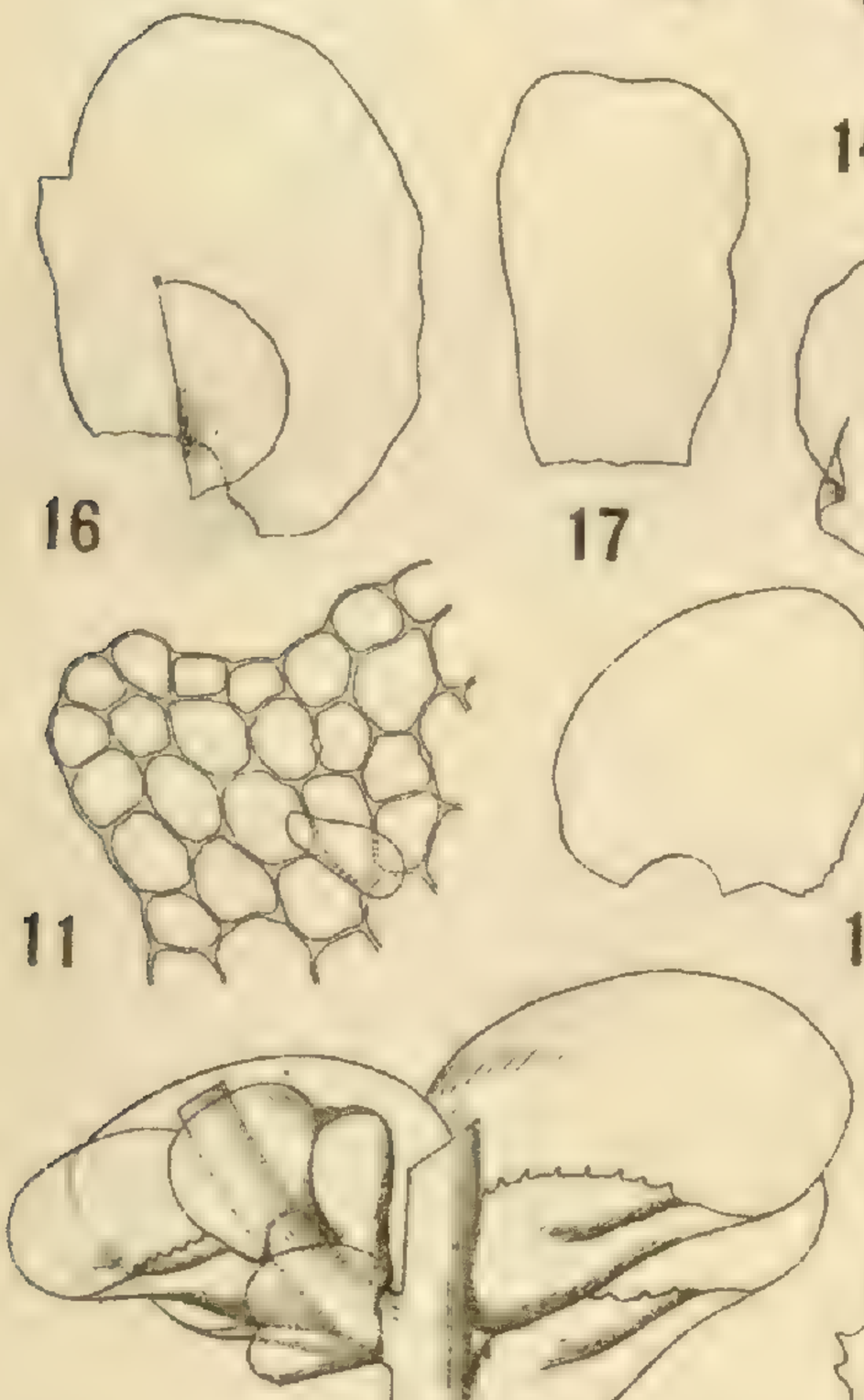
17

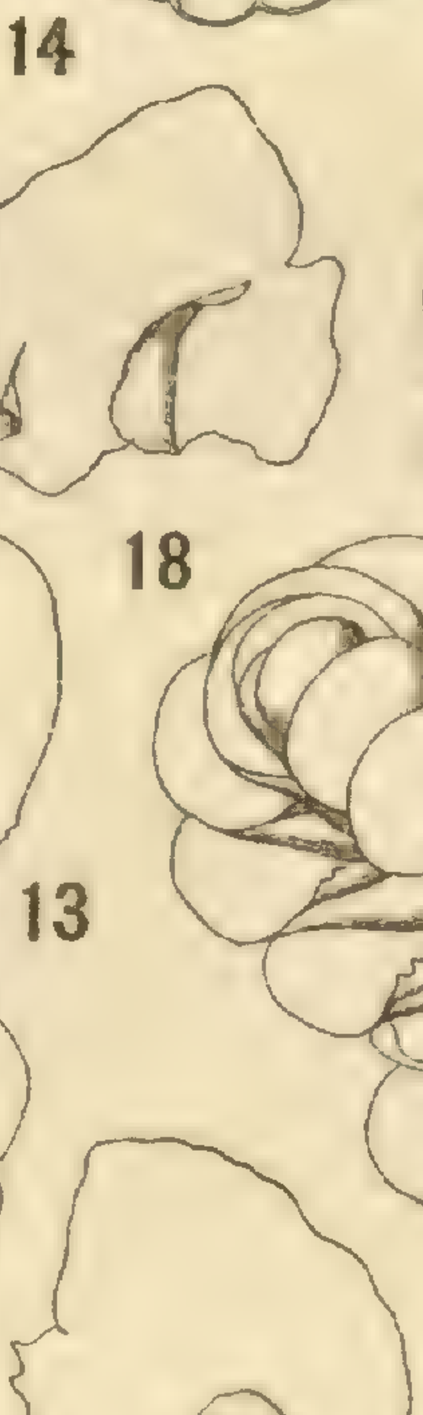

18


11

13

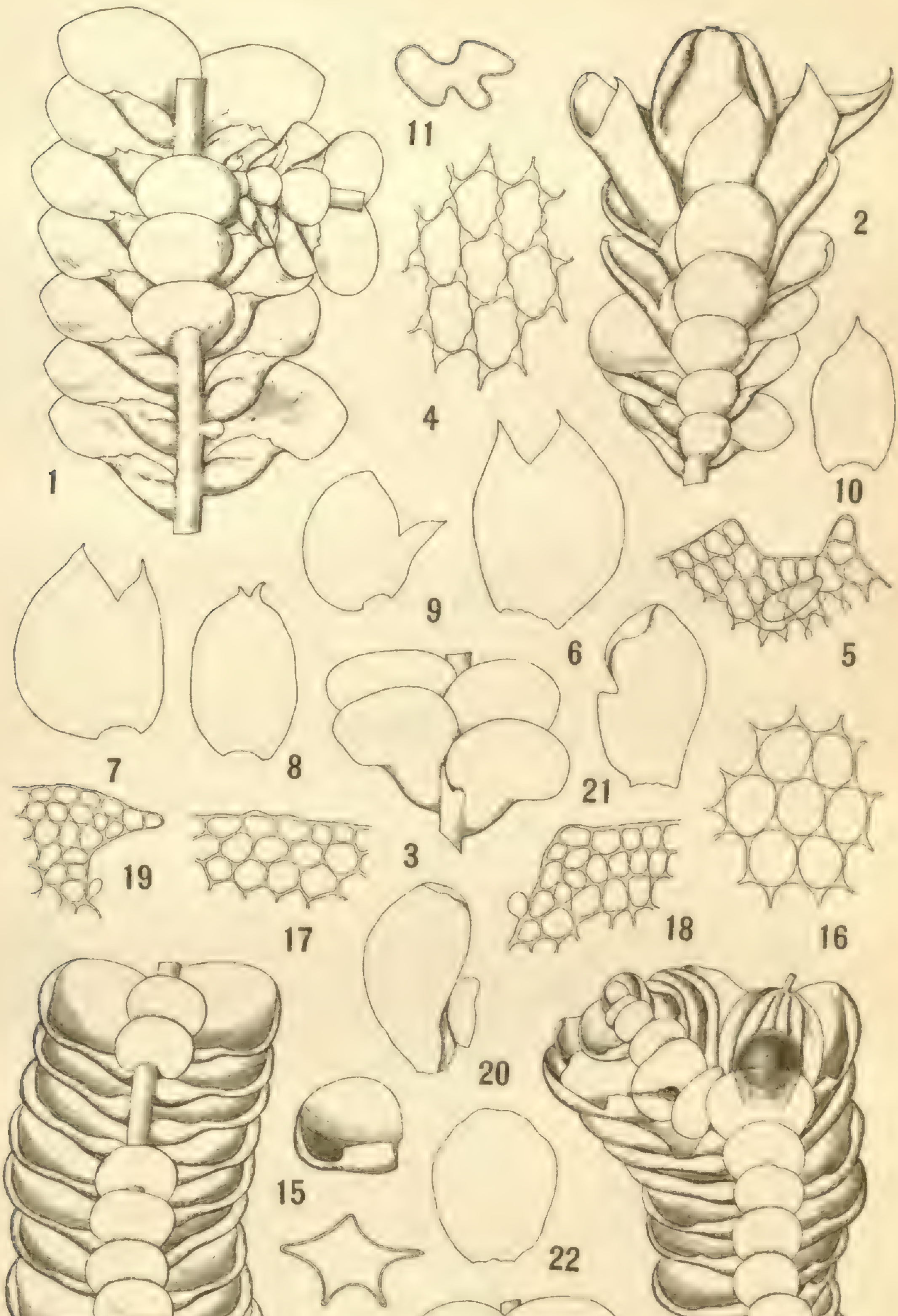

1


2


19

BRACHIOLEJEUNEA INSULARIS Evans.

COCKAYNE, BOSTON

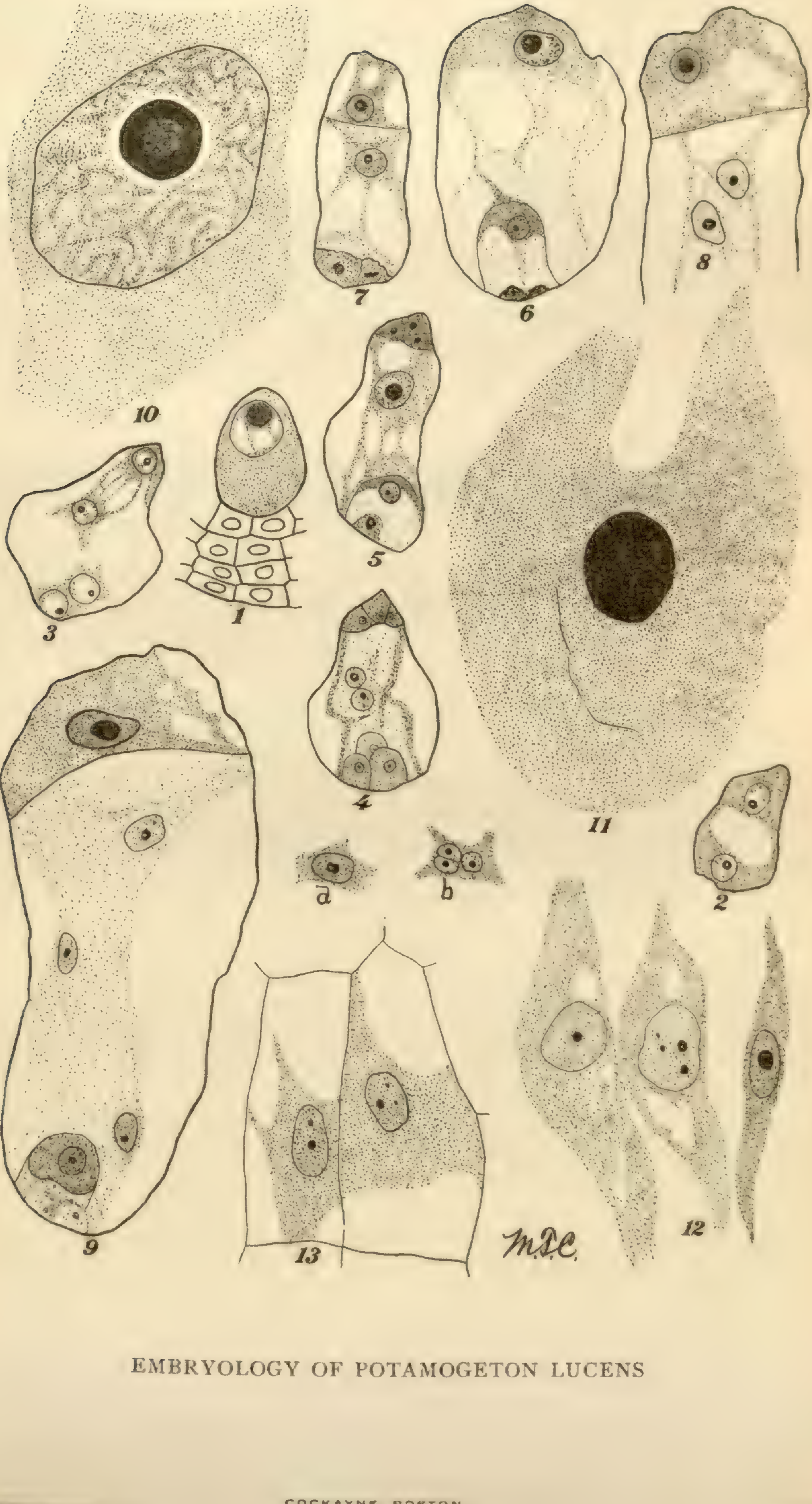


1-11 PTYCHOCOLEUS POLYCARPUS (Nees) Trevis.
12-23 LEUCOLEJEUNEA XANTHOCARPA (Lehm. & Lindenb) Evans.

COCKAYNE, BOSTON

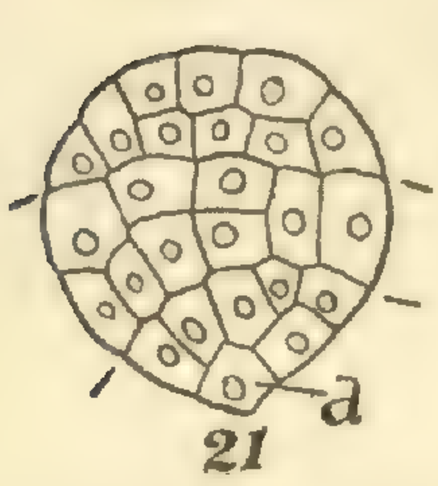
1-8 ARCHILEJEUNEA VIRIDISSIMA (Lindenb) Evans.
9-23 ANOPLOLEJEUNEA CONFERTA (Meissn) Evans.

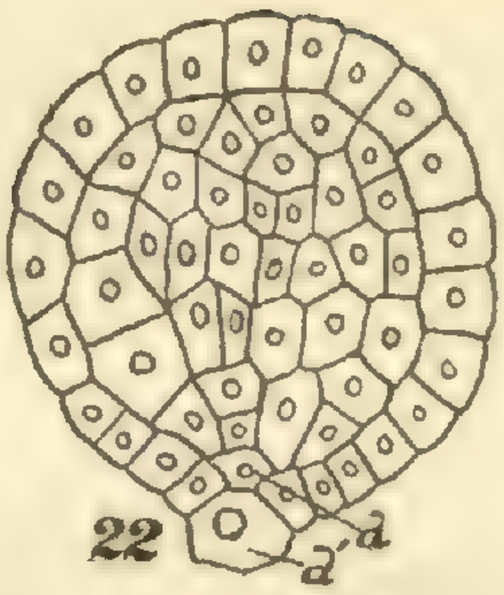
CCCKAYNE, BOSTON

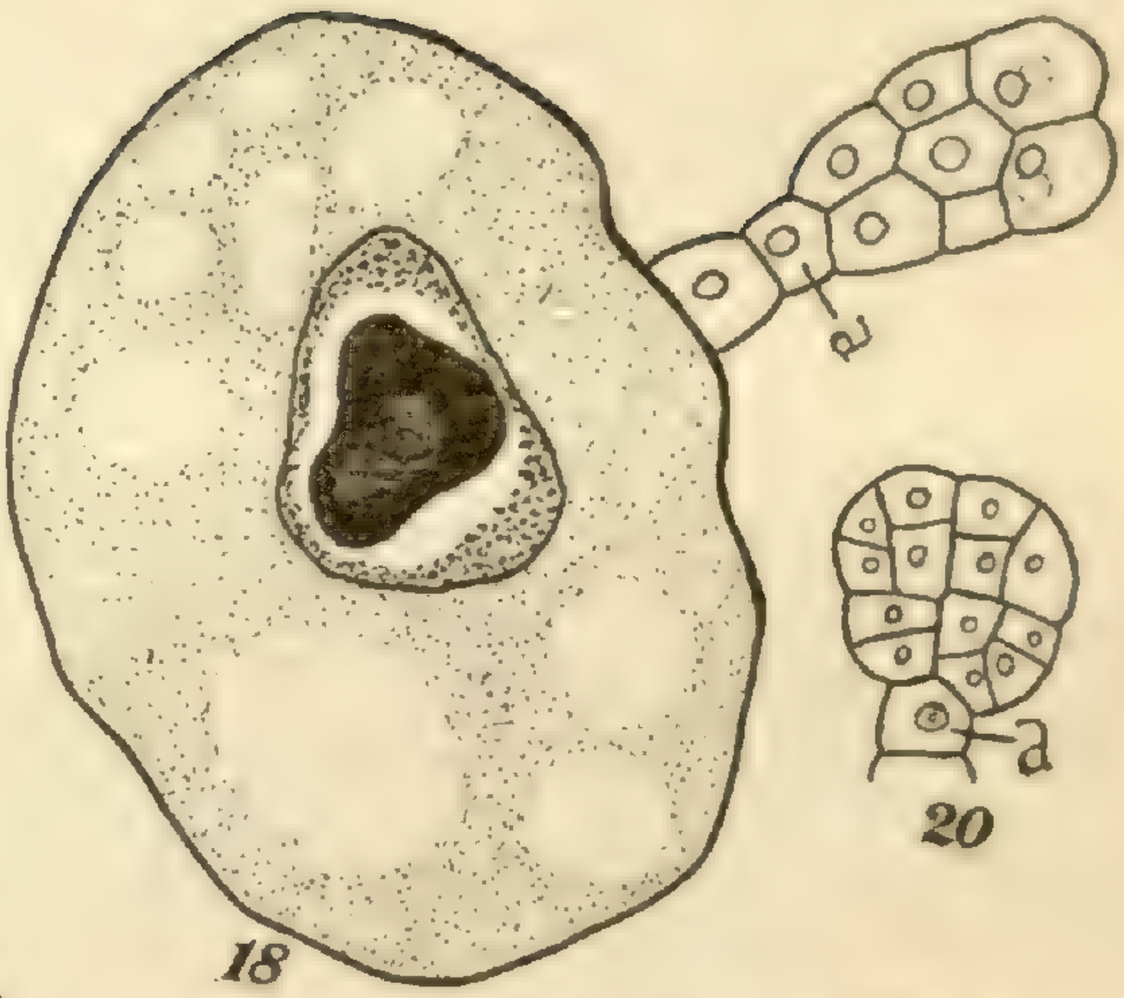


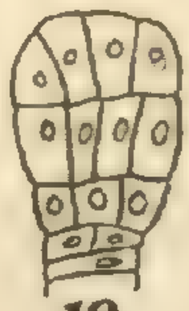
EMBRYOLOGY OF POTAMOGETON LUCENS

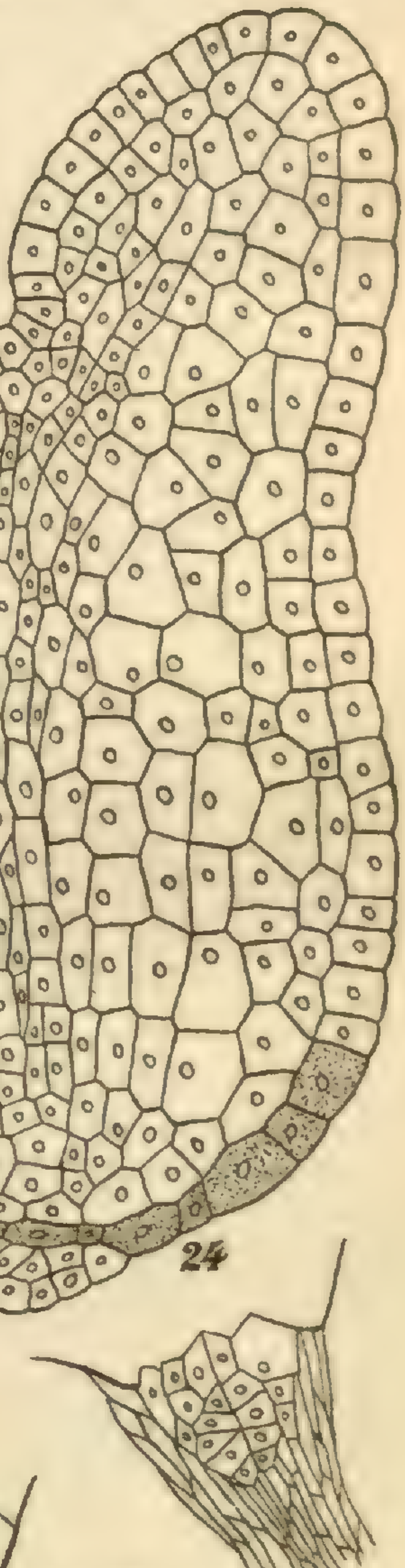
COCKAYNE, BOSTON

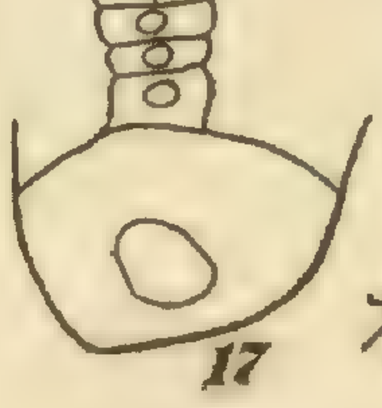


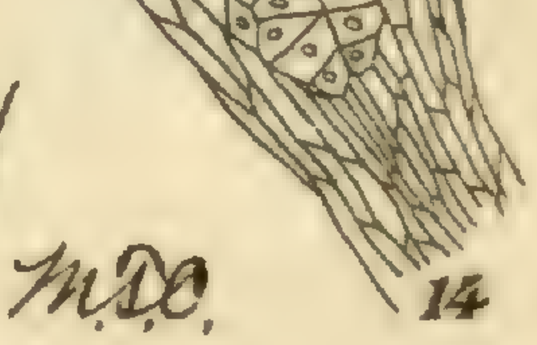












EMBRYOLOGY OF POTAMOGETON LUCENS

COCKAYNE, BOSTON

MEMOIRS OF THE TORREY BOTANICAL CLUB

A series of technical papers on botanical subjects, published at irregular intervals. Price $3.00 a volume. Not offered in exchange.

Vol. 1, No. 1; not furnished separately:

Bailey, Liberty Hyde. Studies of the types of various species of the genus *Carex*. Pages 1–85. 25 My 1889.

Vol. 1, No. 2; not furnished separately:

Martindale, Isaac Comly. Marine algae of the New Jersey coast and adjacen waters of Staten Island. Pages 87–111. 24 Au 1889.

Vol. 1, No. 3; price, 75 cents:

Spruce, Richard. *Hepaticae* Bolivianae, in Andibus Boliviae orientalis, annis 1885–6, a cl. H. H. Rusby lectae. Pages 113–140. 20 Ja 1890.

Vol. 1, No. 4; price, 75 cents:

Sturtevant, Edward Lewis. On seedless fruits. Pages 141–187. 30 My 1890.

Vol. 2, No. 1; not furnished separately:

Halsted, Byron David. Reserve food-materials in buds and surrounding parts. Pages 1–26, *plates 1, 2*. 10 S 1890.

Vol. 2, No. 2; price, 75 cents:

Vail, Anna Murray & Hollick, Charles Arthur. Contributions to the botany of Virginia. Pages 27–56, *plates 3, 4*. 23 D 1890.

Vol. 2, No. 3; not furnished separately:

Holm, Herman Theodor. Contributions to the knowledge of the germination of some North American plants. Pages 57–108, *plates 5–19*. 15 Ap 1891.

Vol. 2, No. 4; price, 75 cents:

Wheelock, William Efner. The genus *Polygala* in North America. Pages 109–152. 30 D 1891.

Vol. 3, No 1; not furnished separately:

Small, John Kunkel & Heller, Amos Arthur. Flora of western North Carolina and contiguous territory. Pages 1–39. 20 F 1892.

Vol 3, No. 2; price, $2.00:

Morong, Thomas. The *Naiadaceae* of North America [with illustrations of all the species]. Pages 1–65, *plates 20–74*. 15 Mr 1893.

Vol. 3, No. 3; not furnished separately:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. [Part 1.] Pages 1–67. 28 Ap 1893.

Vol. 4, No. 1; not furnished separately:

Underwood, Lucien Marcus. Index *Hepaticarum*. Part I, Bibliography. Pages 1–91. 10 Je 1893.

Vol. 4, No. 2; not furnished separately:

Small, John Kunkel & Vail, Anna Murray. Report on the botanical exploration of southwestern Virginia during the season of 1892. Pages 93–201, *plates 75–82*. 18 N 1893–17 Ap 1894.

Vol. 4, No. 3; price, 50 cents:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 2. Pages 203–274. 10 Mr–17 Ap 1895.

Vol. 4, No. 4; price, 50 cents:

Pettit, Anna Stockton. *Arachis hypogaea* L. Pages 275–296, *plates 83–85* 5 Je 1895.

Vol. 4, No. 5; price, 75 cents:

Rydberg, Per Axel. The North American species of *Physalis* and related genera. Pages 297–374. 15 S 1896.

Vol. 5; price, $3.00:

List of *Pteridophyta* and *Spermatophyta* growing without cultivation in northeastern North America. Pages 1–377. 4 D 1893–31 D 1894.

Vol. 6, No. 1; price, $1.25:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 3. Pages 1–130. 17 N 1896.

Vol. 6, No. 2; not furnished separately:

Grout, Abel Joel. A revision of the North American *Isotheciaceae* and *Brachythecia*. Pages 131–210. 30 Jl 1897.

Vol. 6, No. 3; price, 50 cents:

Hazen, Tracy Elliot. The life history of *Sphaerella lacustris* (*Haematococcus pluvialis*). Pages 211–246, *plates 86, 87* (*colored*). 8 Je 1899.

Vol. 6, No. 4; price, 50 cents:

Underwood, Lucien Marcus. A review of the genera of ferns proposed prior to 1832. Pages 247–283. 1 D 1899.

Vol. 6, No. 5; price, 25 cents:

Fink, Bruce. Notes on lichen distribution in the upper Mississippi Valley. Pages 285–307. 1 D 1899.

Vol. 7; price, $3.00:

Howe, Marshall Avery. The *Hepaticae* and *Anthocerotes* of California. Pages 1–208, *plates 88–122*. 5 Au 1899.

Vol. 8, No. 1; not furnished separately:

Lloyd, Francis Ernest. The comparative embryology of the *Rubiaceae*. Part I. Pages 1–26, *plates 1–4*. 26 Au 1899. Part II. Pages 27–112, *plates 5–15*. 15 F 1902.

Vol. 8, No. 2; price, $1.00:

Evans, Alexander William. The *Lejeuneae* of the United States and Canada. Pages 113–183, *plates 16–22*. 15 F 1902.

Vol. 8, No. 3; price, 75 cents:

Britton, Elizabeth Gertrude & Taylor, Alexandrina. The life history of *Vittaria lineata*. Pages 185–211, *plates 23–31*. 30 Au 1902.

Vol. 9; price, $3.00:

Salmon, Ernest Stanley. A monograph of the *Erysiphaceae*. Pages 1–292, *plates 1–9*. 4 O 1900.

Vol. 10; price, $3.00:

Burgess, Edward Sandford. History of Pre-Clusian botany in its relation to *Aster*. Pages i–xii, 1–447. 22 N 1902.

Vol. 11, No. 1; price, $1.75:

Griffiths, David. The North American *Sordariaceae*. Pages 1–134, *plates 1–19*. 30 My 1901.

Vol. 11, No. 2; price, $1.75:

Hazen, Tracy Elliot. The *Ulothricaceae* and *Chaetophoraceae* of the United States. Pages 135–250, *plates 20–42*. 20 O 1902.

Vol. 12, No. 1; price, $1.50:

Northrop, Alice Rich. Flora of New Providence and Andros (Bahama Islands). Pages 1–98, *plates 1–19 + map*. 10 D 1902.

Vol. 12, No. 2; price, $1.00:

Banker, Howard James. A contribution to a revision of the North American *Hydnaceae*. Pages 99–194. 13 Je 1906.

Vol. 12, No. 3; price, 75 cents:

Kupfer, Elsie. Studies in Plant Regeneration. Pages 195–241. 10 Je 1907.

Vol. 13; price, $3.00:

Burgess, Edward Sandford. Species and variations of Biotian Asters, with discussion of variability in *Aster*. Pages i–xv, 1–419, *plates 1–13*. 15 Mr 1906.

Address: **TORREY BOTANICAL CLUB,**
Columbia University, New York City.

VOL. 35 MAY, 1908 NO. 5

BULLETIN

OF THE

TORREY BOTANICAL CLUB

Editor

MARSHALL AVERY HOWE

Associate Editors

JOHN HENDLEY BARNHART
JEAN BROADHURST
PHILIP DOWELL
ALEXANDER WILLIAM EVANS
TRACY ELLIOT HAZEN
WILLIAM ALPHONSO MURRILL
CHARLES LOUIS POLLARD
HERBERT MAULE RICHARDS

CONTENTS

Algal periodicity in certain ponds and streams . . . . HARRY B. BROWN 223
Some Araucarian remains from the Atlantic coastal plain. (Plates 11–16)
EDWARD W. BERRY 249
Notes on Carex — IV . . . . . KENNETH KENT MACKENZIE 261
The water-storing tubers of plants. (Plate 17)
JOHN W. HARSHBERGER 271
Index to American Botanical Literature 277

PUBLISHED FOR THE CLUB

THE NEW ERA PRINTING COMPANY
LANCASTER, PA.

THE TORREY BOTANICAL CLUB

President,

HENRY H. RUSBY, M.D.

Vice-Presidents,

EDWARD S. BURGESS, PH.D. JOHN HENDLEY BARNHART, A.M., M.D.

Recording Secretary,

C. STUART GAGER, PH.D.
Botanical Garden, Bronx Park, New York City.

Treasurer,

WILLIAM MANSFIELD, PHAR.D.
College of Pharmacy,
115 West 68th St., New York City.

MEETINGS

Meetings twice each month from October to May inclusive: the second Tuesday, at 8:00 P.M., at the American Museum of Natural History; the last Wednesday, at 3:30 P.M., in the Museum Building of the New York Botanical Garden.

PUBLICATIONS

All subscriptions and other business communications relating to the publications of the Club should be addressed to the Treasurer, William Mansfield, College of Pharmacy, 115 West 68th St., New York City.

Bulletin. Monthly, established 1870. Price, $3.00 a year; single numbers 30 cents. Of former volumes, only 24–33 can be supplied separately; certain numbers of other volumes are available, but the entire stock of some numbers has been reserved for the completion of sets. Manuscripts intended for publication in the BULLETIN should be addressed to Marshall A. Howe, Editor, New York Botanical Garden, Bronx Park, New York City.

Torreya. Monthly, established 1901. Price, $1.00 a year. Manuscripts intended for publication in TORREYA should be addressed to Jean Broadhurst, Editor, Teachers College, Columbia University, New York City.

Memoirs. Occasional, established 1889. (See last pages of cover.)

Preliminary Catalogue of Anthophyta and Pteridophyta within 100 miles of New York City, 1888. Price, $1.00.

Vol. 35 No 5

BULLETIN

OF THE

TORREY BOTANICAL CLUB

MAY, 1908

Algal periodicity in certain ponds and streams

HARRY B. BROWN

It is a matter of common observation that algal growths may suddenly appear in ponds and streams, persist for a short time, then disappear with equal suddenness. Doubtless many have noticed this in a casual way and wondered why the plant appeared so suddenly, or why it disappeared. In order to answer these questions, or to form even a good opinion of the causes underlying this irregularity, one must study the algal growth in a certain pond or stream at frequent intervals throughout a year or more, noting the different species of algae present, their relative abundance, time of fruiting, etc., and all the external conditions under which the plants are growing at any particular time. These conditions will include amount of light, depth and extent of the body of water, rate of flow and change of water, temperature, amount of mineral matter in the water, cormophytic growth, animal life in the water, and any effect man may have had, as in draining ponds, emptying rubbish, or sewage, etc., into the water.

But little careful and systematic study has been devoted to this subject. Fritsch * ('06) has given the subject some study. In his paper he makes some good suggestions in regard to methods and gives some interesting observations based on a somewhat irregular study.

During April, 1906, the writer began the study of the algae in a small stream flowing across the campus of Indiana University, and in two ponds near Bloomington. This observation extended throughout April, May, and June, 1906. The following

* Fritsch, F. E. Problems in aquatic biology with special reference to the study of algal periodicity. The New Phytologist 5: 150–169. Jl 1906.

[The BULLETIN for April, 1908 (35: 155–222. *pl. 6–10*) was issued 29 Ap 1908.]

September the work was again taken up, additional ponds and streams added to the number under observation, and continued until August, 1907. Collections were made twice a month, material being taken from several different parts of each pond or stream, both on the surface and on the bottom, placed in separate vials, and brought to the laboratory for identification. This was done to avoid error so far as possible in determining the amount of any particular alga present. In nearly every case when an alga was found in any quantity in one part of a pond, it was found in other parts also.

It was thought best to select a limited number of ponds and streams and study these closely. The ones chosen were selected on account of the variety of conditions they presented and the ease with which they might be reached. Five different ponds and two small streams were under observation. The ponds will be designated as ponds nos. 1, 2, 3, 4, and 5, and the streams as streams nos. 1 and 2.

Pond no. 1 is a small body of water in an old sink-hole depression, the bottom of which has become clogged and partly filled with soil. It is about 40 feet across and 4 feet deep during the greater part of the year. During August and September the water becomes low, leaving the bottom bare in places. The pond is fed mainly by underground water flowing through openings in the limestone, which is near the surface in this region. The depth of the water varies with the season but is not much affected by a single rain. A small amount of surface water flows into it, carrying in some red clay from the surrounding plowed field. The water must be changed frequently, for it never seems to be impure. The pond is on a hill in an open field, so there is no shade. On November 10, there were .006 g. of solid matter in 54 g. of the water, or .00011 per cent. of the water was solid matter. *Typha*, *Alisma*, *Eleocharis*, *Potamogeton*, and *Callitriche* grow in the pond rather abundantly, but the animal life is not very extensive, consisting of a few salamanders, frogs, tadpoles, dragon-fly larvae, and a few smaller forms.

Pond no. 2 is a small, shallow pond, about two feet deep and 50 feet wide, fed by a spring near by. This pond is not subject to much variation in depth of water. The flow from the spring is

sufficient to change the water in a day or so, but since the spillway is just opposite the feedway and the pond is wide compared with its depth, the water is not changed frequently enough to keep it very pure. A drove of cows run to the pond; this adds to the impurities. On October 29 the amount of mineral matter in the water was .013 g. in 42 g. water or .0003 per cent. The pond is in the open, so is not shaded in any way. But few of the higher plants grow here, a few specimens of *Eleocharis* and *Alisma;* a few frogs and tadpoles are found in the pond the greater part of the year and some small catfish and sunfish.

Pond no. 3 is a small body of water about 30 feet by 50 and two feet deep. It is fed by a wet-weather branch during the greater part of the year. During July, August, and September, the pond goes almost dry. The water is not changed very frequently, hence becomes stagnant. It is not shaded. *Eleocharis* plants grow in tufts over a part of the pond, especially when the water is low. On December 17 the water contained .0003 per cent. mineral matter.

Pond no. 4 is a body of water covering three or four acres and is about 20 feet deep in deepest part. It is formed by a levee built across a small valley and is fed by a small stream. The water is comparatively pure and clear. It overflows but occasionally. On November 3, there were .011 g. of solid matter in 40 g. water or .00027 per cent. The pond is practically free from animal life; it has but few of the higher plants growing in it and there is but very scant vegetation on the surrounding hillsides, hence it is not shaded.

Pond no. 5, or the water-works reservoir, consists of two large bodies of water fed by several springs. Each covers several acres and is from 10 to 20 feet deep. During late summer and in the fall the water becomes low, but on the whole the depth of the water is not subject to much variation. The water is pure and clear the greater part of the time. There are very few cormophytes growing in these bodies of water, but there are forests on three sides of one and on two sides of the other. Hence they are somewhat shaded along the edges and humus from the woods is washed down into the ponds, the sloping banks being made rich. On October 17 the water contained .00021 per cent. solid matter. Animal life in the ponds is scant—only a few fish.

Stream no. 1 is a small stream that flows across the University campus. Above the campus it has the characteristics of an ordinary small stream flowing across the country. During the greater part of the year this flows briskly with a considerable volume of comparatively pure water. After the stream enters the campus it is greatly changed. It receives the warm water from the bathing rooms, the refuse from the chemical laboratories, and the sewage from the closets in the university buildings. This part flows the whole year. The conditions of the two parts of this stream being so radically different, it may be considered as two different streams. This stream is shaded but little, has grassy banks, and and but few of the higher plants grow in it. A few frogs are found here, snapping turtles, mancelli, and planarian worms. On October 31 the water in the stream above the campus contained .015 g. solid matter in 40 g. of water, or .0037 per cent.

Stream no. 2 is a small stream of cool, clear, pure water flowing through a wooded valley about one fourth of a mile long. It is fed by the outflow of an underground river. The flow of the stream is rapid and continues throughout the year without much variation, the temperature being very uniform, standing about 12° C. The plant life, aside from the algae, is limited to an aquatic *Porella*, and the only animals found here are a few fish, crayfish, gammari, and planarian worms.

Of all the orders of algae found growing in the ponds and streams under observation the order Conjugatae was the most abundant both in quantity and in distribution. Among the forms of this order, *Spirogyra* was the most abundant. It was found in some quantity in all the ponds and streams except in the pond no. 1.

Several different species of *Spirogyra* were found. However, it was often difficult to determine the species when in vegetative state. But several of the most common forms were seen fruiting at some period. In that stage they could be easily identified. *Spirogyra nitida* was the most abundant form throughout the year, appearing in considerable quantity in all the ponds and streams except ponds nos. 1 and 5 and stream no. 2. This species was most abundant throughout the year in pond no. 3 (FIGURE 1 — chart, pond no. 3). In September it was rather rare, floating and healthy. For the next few weeks there was not much change

except that the growth was slightly more abundant; about November 21 it settled to the bottom and collected around the edges of the pond. At this time a good part appeared unhealthy. On

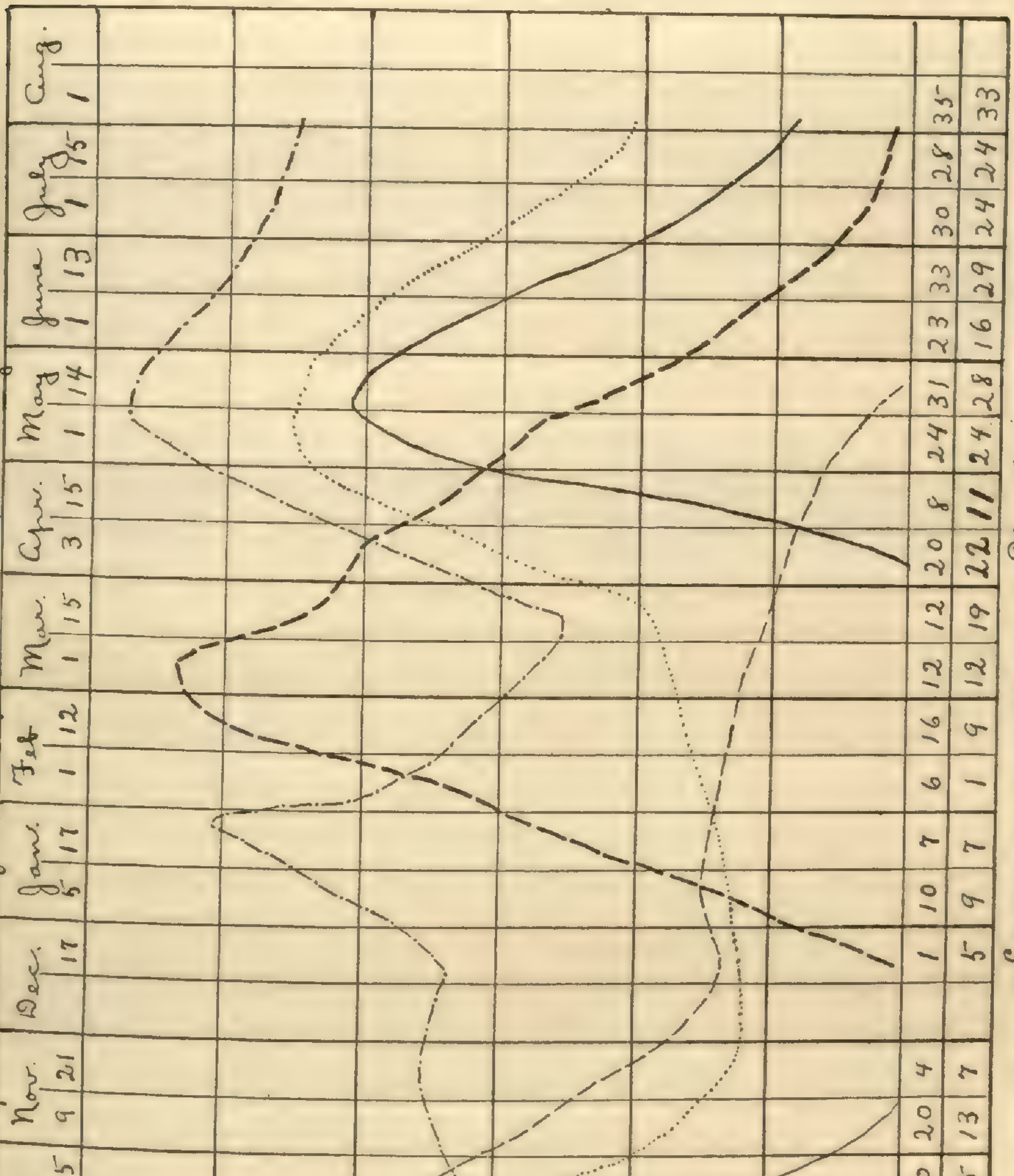


FIGURE 1.

January 5 it had spread out over the bottom of the pond and was dark-green and healthy-looking. It continued to increase in

abundance during the month of January until toward the last, when it began to become more rare and unhealthy. During February and March, the growth became rather rare and unhealthy but showed no signs of fruiting. During April and May, it became very abundant and thrifty in its growth, and continued to be abundant until the first of August, being the dominant alga in the pond. There was no indication of fruiting during the year; conditions did not become hard enough to check the vegetative growth sufficiently to cause the plant to enter the fruiting stage. The fluctuation in the amount of growth from time to time was doubtless due mainly to change in water supply and temperature. Increased growth followed warm rains.

In pond no. 4 *Spirogyra nitida* appeared for but a short time in October when the pond was low. When rains came, the region was covered with deep water. The alga then disappeared. In pond no. 2, a pond with similar conditions, the growth was similar.

None of this species was found in the water-works reservoir. It does not seem to thrive in large bodies of pure water nor in pure flowing water. It was rather rare in stream no. 1 above the campus during October and November, then disappeared. None at all was found in stream no. 2. It was not observed fruiting at any time during the year.

Of the species of *Spirogyra*, *S. varians* ranked second. It was very abundant during a part of the year in ponds nos. 2and 3 and in similar ponds (FIGURE 1—chart, pond no. 3). From September to January, this species was rather rare in all the ponds and streams. On January 23 it was found to be very abundant in pools on the ground in open fields in different places where the water had been standing several days. On February 12 it was very abundant in ponds no. 2 and no. 3. It continued to be abundant, in a healthy vegetative condition until the middle of April, when it began to look unhealthy, diminishing considerably in quantity. During February and March, it was near the bottom of the ponds, but when it became unhealthy-looking in April it was floating. It has not been observed to fruit in these ponds. That found in wet-weather pools has been observed to begin conjugation every time the pools start to dry up. After each rainy period conjugation

ceased and the plant multiplied rapidly vegetatively until the water began to get low again. This species appeared in stream no. 1 above the campus during October (FIGURE 2—chart, stream no. 1), but

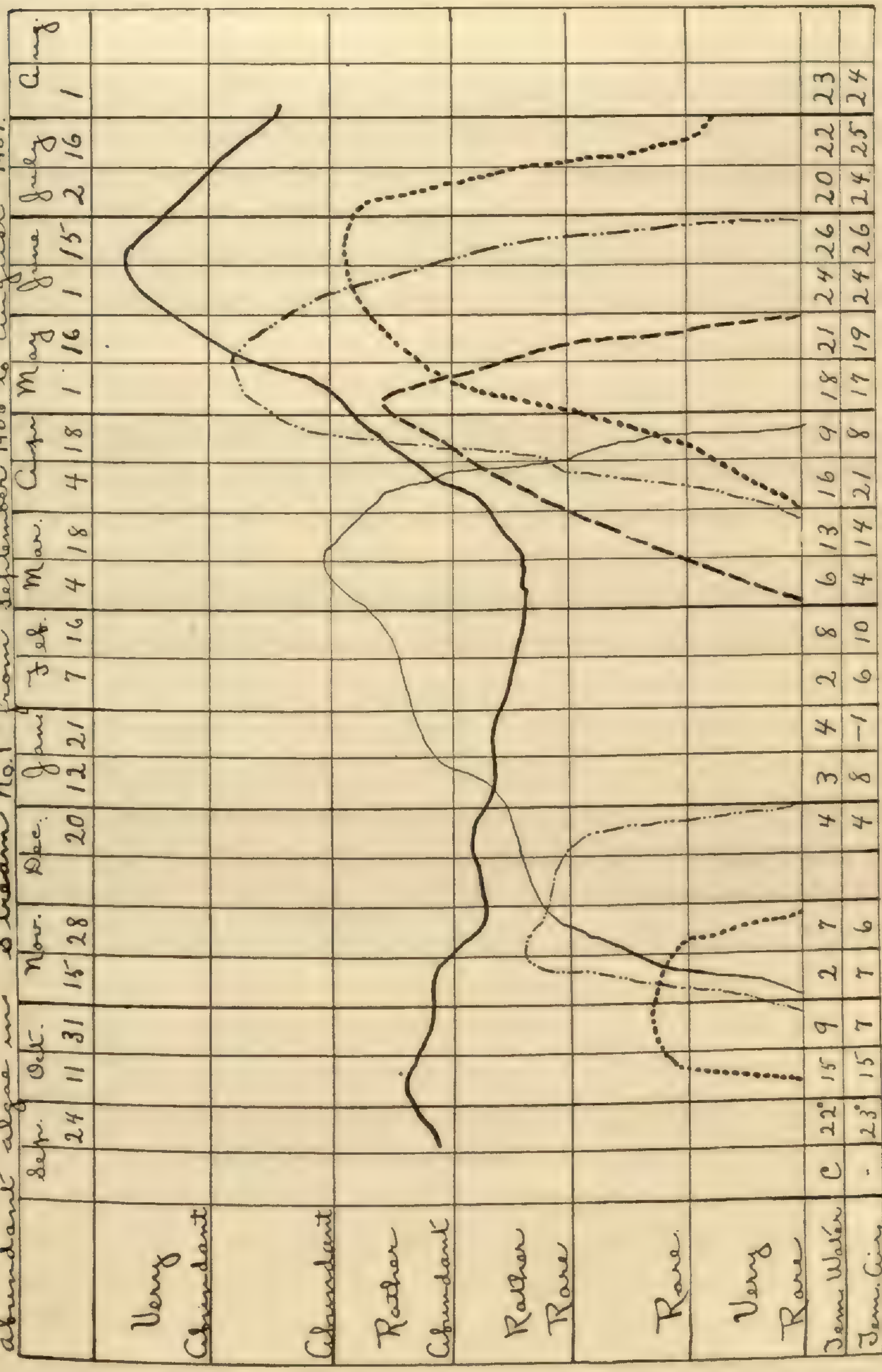


FIGURE 2.

was never very abundant. Some was noticed forming spores on November 15. Spores were formed in cells of the filament without

any evidence of conjugation either between cells in the same filament or with cells in another filament. The spores produced resembled zygospores closely. These were likely aplanospores, such as described by West* ('04). None of this species was found after November until about the middle of April, when it became abundant in the upper part of the stream. This was not in a healthy vegetative state. It remained in about the same condition throughout April and early May, not healthy, fruiting to some extent. (Doubtless this that appeared in the stream in April was washed out of a pond farther up the valley.) *S. varians* seems to attain its maximum growth at a temperature considerably lower than that at which *S. nitida* attains its maximum.

Spirogyra crassa was found to be rather abundant in a bayou along the edge of the larger of the water-works ponds during August, 1906. This disappeared with the drying up of the bayou in September, and it has not since appeared. On October 12 the same species was found to be rather abundant in an old bayou along stream no. 1. This bayou is about 10 feet wide, 2 feet deep, and 40 feet long. It has been formed by the "branch" during high water but is not connected with it directly at present. The alga continued to be rather abundant during October and November and in a healthy growing state. In December it became very abundant, spread out over the pond, sank to the bottom, took on a dark-green color and remained very abundant until the first of May. During the winter it did not grow much, although it seemed to be green and healthy. About the first of May, it was not quite so plentiful, nor so healthy as formerly. Later in May, it disappeared altogether. It seemed to become unhealthy and very slimy looking. Just what caused this the writer is not able to state. Possibly a certain amount of sewage or chemicals from the chemical laboratory was washed into the bayou during high water a few days before the disappearance of the alga. The alga was not carried away by the water. It did not conjugate.

Some other species of *Spirogyra* were found at different times but in no great quantities. During December, *S. inflata* was found in limited quantity in one corner of the smaller of the water-works ponds where the water was not very pure. Some decaying vege-

* West, G. S. British Freshwater Algae, 123. 1904.

tation resulting from cormophytic plant growth the previous summer, and the refuse from the pumping station near by, tended to make the water here impure. This was fruiting freely when found and was not found afterward.

Spirogyra Weberi was found in the upper part of stream no. 1 in October in very small quantities and it was rather abundant in pond no. 3 during September and October. It became rare the first of November and disappeared later in the month. No conjugation was noticed although it might have taken place in short time and the whole plant growth disappeared, or it might have been so scattering that it was not noticed, the plant not being very abundant. A few other species were found in small quantities but no attempt was made to follow them in their periodicity.

Among the filamentous forms of Conjugatae, *Zygnema* ranked next to *Spirogyra* in abundance and distribution. It was found in some quantity in several of the ponds but not in great abundance in any case. In stream no. 1, *Zygnema insigne* appeared during October, became rather abundant, then gradually disappeared in November. It was not observed to fruit. On April 18, *Zygnema leiospermum* was found in the upper part of the stream just below a pond in which the species had been growing. It was rather rare, not growing or healthy looking, and was fruiting to some extent. This species continued to be present in small quantities until the first of August. The same species was rather abundant in pond no. 3 during the latter part of September, 1906. It was pale-green and unhealthy looking, and mixed with *Spirogyra*. It became rare during October and disappeared the first of November. A few scattering filaments of *Z. leiospermum* were found in pond no. 2 during November, 1906, and also during the following May. *Z. cruciatum* was found to be rather abundant in pond no. 1, March 14. It was not very healthy in appearance and remained in about the same condition until the latter part of May, when it began to grow, became more healthy, and more abundant. It was along the edge of the pond in shallow water — some of it floating. This disappeared in June.

Mougeotia was not very abundant at any time in the waters under observation. A few species were found in limited quantities. *Mesocarpus radicans* was found on April 4 in small quantity

in the smaller water-works pond, among a growth of *Typha*. It was not seen there again but was found in a water-trough near by, in which there was flowing water. It was rather rare here during April and May, then disappeared. *Mougeotia scalaris* (*Mesocarpus scalaris*) was found in the upper waters of stream no. 1, October 1. It was rather abundant and unhealthy looking and became more rare and unhealthy the latter part of October and in November. None was noticed after November 15 until March 4, when a small amount was found in an unhealthy condition; it did not seem to be growing any and had doubtless passed the winter in that condition. During May it began to grow and again became rather abundant. Following this it became rare but persisted throughout the summer. Small quantities of *Mougeotia parvula* (*Mesocarpus parvulus*) were found in small pools of water in the upper part of stream no. 1 in May. The water here was slightly stagnant, not flowing freely. This was rather abundant in stagnant pools until the first of August.

Another filamentous form of the Conjugatae found was *Mougeotia genuflexa* (*Pleurocarpus mirabilis*). This was rather abundant in the lower part of stream no. 2 during the latter part of October and in November. Many filaments were bent at nearly right angles and the angles were united as if the cells were conjugating but nothing to indicate the passage of cell contents was observed. No spores were seen. On June 3 this plant was found floating in the upper part of the larger of the water-works ponds, near where it was found in stream no. 2. It was rather abundant and not very healthy and seemed to be in an early stage of conjugation similar to that which was seen in November. Later in the summer, this species was found floating in several places in both of the water-works ponds. In every case certain cells were bent as described above and connected with similar cells in other filaments. The plant always appeared to be unhealthy.

Representatives of six genera of the family Desmidiaceae were found but only a few species in each genus — one in some. *Closterium* appeared to be the most abundant, both in quantity and distribution, appearing in four different ponds. *Closterium acerosum* was especially abundant in pond no. 2. Here it was noticed October 29, rather rare but in a healthy growing condition. It

became rather abundant during November and December, then, increasing by cell division, it became very abundant in January. During February and March, the plant began to look somewhat unhealthy and was only rather abundant. During April and the first part of May, it again became healthy, grew rapidly, and became very abundant. Later in May, it began to be rare again. Following this, it became very rare and disappeared in June. In pond no. 3, this form was found during the greater part of the year but never in abundance. There was some fluctuation in amount, becoming rather abundant in November, then rare (FIGURE 1 — chart, pond no. 3).

In the upper part of stream no. 1, *Closterium acerosum* was noticed September 24. It was rather abundant, growing among filaments of *Spirogyra*. It became less plentiful during October and disappeared during November. In every case *C. acerosum* was found growing with *Spirogyra*, either among the filaments or on the bottom. Just what caused the fluctuation in the amount of the plant, is not easy to explain. It was probably not due to temperature, for in one instance when most abundant, in January, the temperature was low, 5° C. and in another, in April, it was rather high, 18° C.; it became rare in February under a low temperature, 1° C., and rare in May under a temperature of 26° C. It is doubtful if the animal life of the pond had any bearing on the matter. There were few small animals in the pond that would likely feed on the desmids. The periods of greatest abundance seemed to follow seasons when the water was lower and more impure. This doubtless had some influence on the growth, for in some experiments, to be mentioned later, it was found that if the liquid in which the desmids were growing became more dense, cell-division would be more frequent.

A few specimens of *Closterium Ehrenbergii* were obtained from pond no. 1 during November and also during May. On May 14 a good quantity of this species was found growing among filaments of *Cladophora* in a large glass jar in the University greenhouse. This material was so rich in desmids that thousands of them could be obtained free from impurities by rinsing a small mass of the *Cladophora* in a small vessel of water a moment or two. After obtaining the desmids in this way, they were placed in a large

crystallizing dish in which there was a small amount of *Cladophora* growing. By filling the vessel with water every few days the desmids were kept growing for several months and a careful study was made of them. The vessel was kept in the greenhouse where the air was damp and the temperature moderately high and steady. At certain times these desmids were found to divide so as to reproduce themselves vegetatively much more abundantly than at other times. Different causes seemed to induce this. If the water began to get low in the vessel so as to make the solution more dense and richer in salts, division appeared to be more active; if placed on agar saturated with normal culture-solution, they divided more abundantly; if placed in a small crystallizing dish on the oven, so as to change the temperature suddenly to a relatively high temperature, 26° C., in 48 hours, one half of the number were in the process of division. A sudden change, or hard conditions seemed to induce cell-division. The cells that divided on the agar preparation, and the ones that divided in the vessel on the oven did not develop into two healthy, full-sized specimens; the ones in the vessel kept in the greenhouse required from six to eight days after cell-division could be first noticed for the daughter semi-cells to reach full size.

Experiments similar to the above were tried with *Closterium acerosum*, with similar results.

A very few specimens of *Cosmarium* were present in all the ponds and streams throughout the year, but in no case were they found in any abundance. On April 30 a few *Cosmarium* zygospores were found in pond no. 1. *Docidium Trabecula* was rare in pond no. 3 during October and November, and a few specimens were obtained from pond no. 2, January 14. *Hyalotheca* and *Staurastrum* were present in the spillway of pond no. 4 in very small quantities in December. A few specimens of *Penium interruptum* were found in the lower part of stream no. 1 during June, 1907. This species appeared in the water-works reservoir about the same time.

The Oedogoniales ranked second in abundance, considering quantity, and they were rather generally distributed in the ponds and streams under observation. *Oedogonium* and *Bulbochaete*, representing the two genera in the family Oedogoniaceae, were found, *Oedogonium* being quite common and *Bulbochaete* rather rare.

Oedogonium crassiusculum was abundant and the dominant alga in pond no. 1, September 20 (FIGURE 3—chart, pond no. 1.) It was mostly attached to dead *Typha* stems and other stems under water.

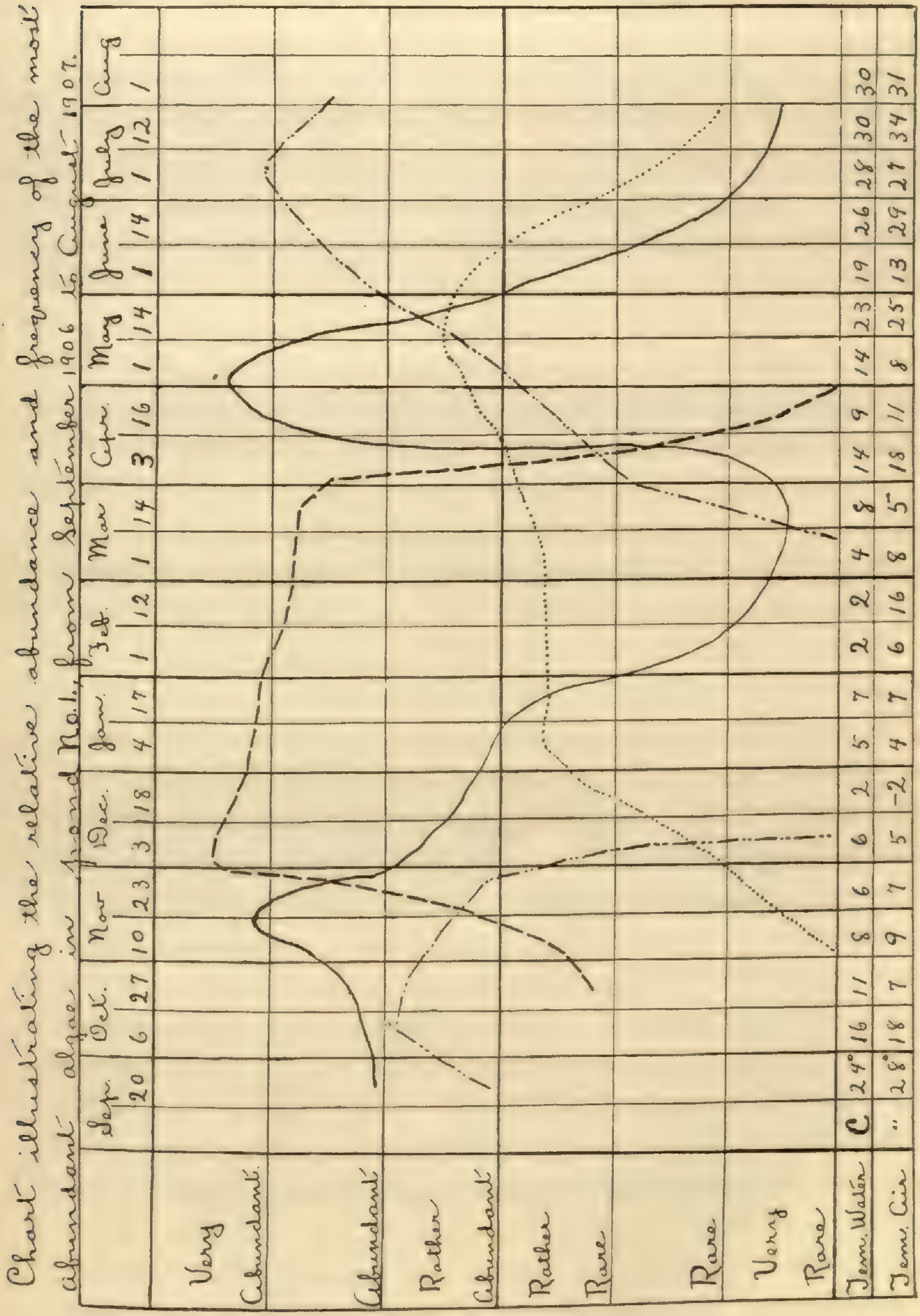


FIGURE 3.

A few filaments were fruiting. It became more abundant during October, continuing to fruit to some extent. In November it be-

came more healthy and thrifty looking and fruiting filaments became rare. During December and January, the plant was rather abundant in sort of a resting state — not growing any, living, but crusty looking, due to particles of soil and diatoms clinging to the filaments. A similar condition continued throughout February and the first half of March, except that the plant became more rare. Between my visits to the pond on March 14 and April 3, considerable change took place. On the latter date there was in the pond a considerable amount of the alga floating in unattached masses. This seemed to be rather healthy looking and was just beginning to fruit sexually, dwarf males being numerous. The warm weather and sunshine of the latter half of March must have caused vigorous growth and as the filaments became older and longer they became free-floating. On April 16 this floating form had become abundant near the surface, especially around the edge of the pond, and the fruiting organs were very abundant. This began to disappear during the latter part of April and by the middle of May had entirely disappeared. The part attached continued to be about the same until the latter part of May, when it became more rare, brownish and not very healthy looking. It remained very rare and unhealthy until August.

This alga did not appear in any of the other streams and ponds under observation except in pond no. 2. It was found to be abundant here October 11 — scattered all over the pond, some attached to *Eleocharis* and *Potamogeton* plants but the most free-floating. The plant became more abundant during the latter part of October and the first part of November. In the latter part of November it became unhealthy looking, less abundant, and settled to the bottom. It disappeared altogether in the first part of December. The floating masses were not observed fruiting. Some few of the attached filaments bore sexual organs. The floating masses appeared here as suddenly as in pond no 1. It disappeared more slowly; the loose, floating masses were mainly washed out of the pond.

Oedogonium cryptoporum appeared in three different ponds, nos. 3 and 4 and the larger of the water-works ponds, but not in much abundance in any one. A small amount was found in September, October, and the first part of November. Later in

November it disappeared, not appearing again until the middle of the following April. It then became rather abundant, reaching its maximum in the first half of May. On May 18 it was fruiting abundantly. About the first of June, it had become very rare in most places, entirely disappearing in some.

The causes of this periodicity of *Oedogonium* are not easy to explain; only a few facts can be pointed out that probably had an influence. The increase in the amount of *Oe. crassiusculum* in November was not very great. Doubtless a good portion of this passed the summer in a sort of resting condition — the filaments growing but little — then, when rains came in November, increasing the amount of water in the pond, there was growth. Following this time, the temperature became too low for much growth and the alga became more rare, yet a relatively small amount persisted throughout the winter in a resting state. When heavy rains came in March, accompanied by warm weather, there was a rapid growth for two or three weeks. As the temperature of the water became higher and the light more intense, the alga was caused to pass from a vegetative to a fruiting state and after fruiting it began to disappear rapidly. Klebs* (1896) found in experimenting with *Oedogonium* that increasing the intensity of light would tend to cause an increase in the production of sexual organs.

Bulbochaete crenulata appeared in pond no. 1 about November 23, and persisted during the winter in small quantity, growing but little. About the first of May, it had become slightly more abundant, was growing somewhat, and bearing sexual organs. Later in May it disappeared. On July 31 a small amount was found attached to grass in the upper end of the larger of the water-works ponds. It was in a vegetative state and did not appear to be growing much.

The Chaetophorales were tolerably abundant in the ponds and streams studied and rather generally distributed, the genera *Chaetophora* and *Draparnaldia* being the most abundant.

Representatives of but two genera were found belonging to the family Ulotrichaceae; these were *Ulothrix* and *Stichococcus*. *Ulothrix aequalis* appeared in pond no. 1 about the middle of

* Klebs. Die Bedingungen der Fortpflanzung bei einigen Algen und Pilzen. 1896.

March, growing with *Vaucheria* and not attached. This was rather healthy and growing for a time. It became rather abundant on the east side of the pond during the latter part of April and the first of May. Then it began to become unhealthy looking, the cells of the filaments coming apart. From this time on it gradually disappeared, none being found June 25. *Ulothrix zonata* appeared in the lower part of stream no. 1 the middle of July. It seemed to be healthy and growing, was a bright-green, with filaments a foot or two long, attached at one end, the other floating. It disappeared in a few weeks. A small amount of *Colcochaete scutata* was found in pond no. 1, July 8, clinging to dead submerged *Typha* stems.

A small amount of *Stichococcus* was found growing on the dry clay soil clinging to the roots of a large tree that had blown down along stream no. 2. The soil was sheltered so that it was usually rather dry. This was first noticed early in the winter. It remained in a growing stage during the entire winter, reaching its maximum abundance in March. During the latter part of May and the first of June, it disappeared. Doubtless the soil became too dry and the temperature too warm.

A limited amount of *Herposteiron* was epiphytic on *Oe. crassiusculum* in pond no. 1 during March and April.

Representatives of three genera belonging to the family Chaetophoraceae were found — *Chaetophora*, *Myxonema*, and *Draparnaldia*. *Chaetophora* was the most abundant, appearing in considerable quantities in pond no. 1 and stream no. 1 (see charts).

Chaetophora pisiformis was rather abundant in pond no. 1, September 20, 1906, appearing as small glistening greenish globules attached to submerged objects. It continued to be rather abundant until the last of November, when it disappeared; appearing again about the middle of March, it spread over the pond and became very abundant in distribution especially, coating nearly everything submerged in the pond. It continued abundant to the first of August, being the dominant alga of the pond the greater part of the time. The same species appeared in the upper part of stream no. 1, November 15. It was abundant for about a month, attached to sticks, grass, and stones on the bottom of the "branch." The masses here seemed to be much larger than

in pond no. 1, as large as a pea, light green and bladder-like. It disappeared the last of December, appearing again the first of April. It became very abundant during the last of April and the first of May — the dominant alga. It began to be more rare the last of May and had entirely disappeared by the last of June. The animal life of the stream doubtless had something to do with its disappearance. There were numerous tadpoles in the "branch" and it was noticed that in pools in which there were many tadpoles there was no *Chaetophora*. The disappearance during the winter was likely due to low temperature.

Chaetophora endiviaefolia was found to be rather abundant, attached to objects on the bottom in the upper part of stream no. 1, November 15, 1906. A little later it became rare, but persisted in small quantities during the winter. In March it began to increase in abundance, becoming very abundant about the middle of April. This continued until about the first of June, when it began to disappear. By the last of June, it had entirely disappeared. This species was doubtless affected by the same agencies as the preceding form.

Draparnaldia plumosa appeared in the upper part of stream no. 1 about the middle of November, 1906 (see chart). It seemed to be healthy and growing. It varied in abundance during the winter, being usually rather rare or rather abundant. Floods washed away large quantities, making it rather rare at times. Material brought into the laboratory on February 16 showed numerous zoöspores in 24 hours. This plant reached its greatest abundance in March. After this it began to disappear and by the last of April had disappeared altogether. This plant appeared in several other places, but in every case the conditions were very similar. It seems to thrive in flowing surface-water at a temperature ranging from 0° to 15° C. In no case was the plant found in a pond.

Two species of *Myxonema* were found, *tenue* and *nanum*. *M. nanum* persisted throughout the year without change on wet rocks at outlet of sewer on campus. The conditions under which it was growing were not subject to much change, the water being warm continually, about the same in amount and always richly laden with sewage. *Myxonema tenue* was first noticed in the lower part of stream no. 1 April 18. The filaments were attached at one end,

floating in long ribbons. Material brought into the laboratory produced numerous zoöspores in a few hours. This form persisted until the first of August, becoming rather rare at times.

The only species found belonging to the order Cladophorales was *Cladophora glomerata*. This species was present in the upper part of stream no. 1 (see chart) throughout the year. During only a few months in the spring, ranging from the middle of April to the middle of June, was there much growth. During this time it grew rapidly so as nearly to fill the channel of the stream. Its growth was checked at the end of this time, doubtless by the water becoming low, impure, and warm. During the rest of the year the filaments that persisted were unhealthy looking, the cells had thick walls and were crusty looking, due to particles of sand and diatoms clinging to them. It was noticed in several places that where the plant grew in swift water the filaments were much branched; in quiet flowing water there was but little branching. *Cladophora* was not found in a healthy growing state in any of the ponds. Small masses were found in some, but it was not in a healthy condition and had doubtless floated in from a feeding branch. *Cladophora glomerata* transferred from stream no. 1 to stream no. 2 and anchored in the latter failed to grow. This stream has purer water, flows swiftly and has a relatively lower temperature than the first, standing at about 12° C. continually.

The only representatives of the order Siphonales found in the regions studied were two species of *Vaucheria*, *V. sessilis* and *V. geminata*, var. *racemosa*. *V. sessilis* was very abundant on the damp, sloping banks all around the larger of the water-works ponds October 4. It continued to be abundant and healthy, growing vegetatively until the first of November, when it began to bear sexual organs. It was fruiting considerably the middle of November. On the fourth of December it was looking yellowish, unhealthy, and seemed to be loosened from the ground, due to the ground freezing and thawing. On December 21, the ground was covered with snow, but in places small patches of *Vaucheria* could be seen, unhealthy in appearance. Ripe oöspores were found in it. They were no doubt "seed" for next year's crop. On January 10 the banks were in the main covered with water due to a rise in the pond, and no *Vaucheria* was to be seen. It did not reappear before the close of the study, the first of August.

Vaucheria geminata var. *racemosa* was found in pond no. 1, October 6 (see chart). It was rather rare, growing in shallow water and fruiting somewhat. During the first of November the pond dried up in parts, but the *Vaucheria* continued to grow freely, forming a dense felt over the rich damp earth on the bottom of the pond. On November 23 this was covered with about a foot of water. The submerged *Vaucheria* showed some signs of decay. It remained in about the same condition, unhealthy looking until the twelfth of February, when it was found that the old filaments were covered with fruiting organs. Some of the felts remained attached to the bottom, while others loosened and floated around. They persisted until the last of March, when the filaments turned black and decayed. The pond is surely well sown with spores. The change in conditions due to the flooding with water more than likely caused the formation of the reproductive organs. An aquatic form grew throughout the year in stream no. 2 near the spring. Here there was but little variation in the condition, quantity, or temperature of the water. There was no change in the alga. No sexual organs were produced. This seems to show that under steady favorable conditions an alga continues in a healthy, growing, vegetative state continually. It was not possible to determine the species of this alga.

Numerous representatives of the order Protococcales were found but they were nearly all found only occasionally and in very small quantities. On account of this we will pass by all of them except *Tetraspora* with a mere mention at the end of this sketch. *Tetraspora lubrica* began to appear in the upper part of stream no. 1 the first of March (see chart). It increased in abundance until the first of May, when it reached its maximum. By the end of May, it had disappeared. This alga seems to thrive in "branch"- or surface-water when flowing freely and at a temperature from 5° to 20° C. Certain other colonial forms belonging to the same order, *Gonium*, *Pandorina*, *Pediastrum*, *Coelastrum*, and *Scenedesmus*, appeared in the more stagnant pools of the upper part of stream no. 1 during June and July, 1907.

A number of species of Bacillariales were observed but no effort was made to classify them or trace their periodicity.

The Cyanophyceae were not very plentiful in the regions

studied except in two places, the smaller of the water-works ponds and in the lower part of stream no. 1. This class of plants seems to thrive best in impure water. The water-works pond just mentioned, taken as a whole, contains relatively pure water, but at one corner near the pumping station it was very impure, due to the oil and refuse from the pumping station flowing into it. Here there was always a good amount of the Cyanophyceae to be found growing. From this place they floated out and settled around the edge of the whole pond.

Two species of *Nostoc* appeared in the territory studied, *N. verrucosum* and *N. commune*. *N. verrucosum* persisted throughout the year in stream no. 1 with very little change. At times it appeared to be less abundant but this was due to the water washing away a part during floods. It was attached to the stone bottom of the "branch" in the swifter parts. It grew up in hollow subglobular masses five or six centimeters in diameter. They were at first pale yellowish-green, rather firm, jelly-like masses, but the outer part soon became incrusted with lime so as to make it harsh and crusty. Soon after reaching this stage the flow of the water caused them to break loose and float away. No heterocysts or spores were noticed.

A small amount of *N. commune* was found growing on the damp soil along the edge of pond no. 3, September 20, 1906. The region was covered with water at my next visit and none of the alga was found. The same species was found growing in a similar place along the upper part of stream no. 1, October 11. It continued to grow here and was rather abundant until the middle of November, when it disappeared.

Scattering filaments of *Anabaena* were found at various times during the year in material collected in the lower part of stream no. 1, pond no. 1 and the smaller of the water-works ponds, but no attempt was made to trace the periodicity.

Three different species of *Oscillatoria* appeared in considerable abundance in the ponds and streams under observation. These were *Oscillatoria tenuis*, *O. limosa* and *O. princeps*. Some other species were noticed but they did not persist any length of time. *O. tenuis* was the most abundant form both in quantity and distribution. It was abundant in stream no. 1, especially in the

lower part, and in the smaller of the water-works ponds during the greater part of the year. In stream no. 1 it grew on the stones in the bottom, forming a tolerably dense stratum. A similar stratum formed on the rocks at the outlet of pond no. 4 whenever sufficient water flowed over the spillway to keep them wet. Around the edge of the smaller of the water-works ponds there was usually a stratum covering the bottom in the shallow water. Whenever sufficient oxygen collected in the meshes of a mass it was loosened and floated on the surface.

Oscillatoria princeps (*O. Imperator* Wood) was found to be rather abundant in the most stagnant part of the smaller of the water-works ponds during the latter part of September, October, and the first of November, 1906. It appeared again the first of June, 1907, and continued to be rather abundant until August. It appeared also in ponds nos. 2 and 3, going through a similar periodicity.

Oscillatoria limosa (*O. Froelichii* Kütz.) appeared in all the ponds and streams except pond no. 1 and stream no. 2, being especially abundant in pond no. 2 and stream no. 1 from December to the first of May. It seems to thrive well in foul water. It seemed to become more abundant in pond no. 2 when there was considerable cow-manure around the edge of the pond. Cattle had access to the pond only a part of the time.

Calothrix parietina (*Isactis caespitosa* Wolle) was abundant on the stones in the bottom of stream no. 2 the entire year, changing but very little. The conditions under which it grew were unchangeable.

CONCLUSIONS *

An alga growing under steady normal conditions continues, in the region studied, to grow in a healthy vegetative state throughout the year. *Nostoc verrucosum*, *Calothrix parietina*, and the *Vaucheria* growing in stream no. 2 showed this, and also the *Myxonema nanum*, growing at the sewer outlet.

A sudden change in external conditions checks the vegetative growth of an alga and tends to cause it to enter a resting stage form or to fruit sexually.

* For local observers I may state that stream no. 1 is known as Jordan Branch; stream no. 2, Stone Spring Branch; pond no. 1, Hill Pond; pond no. 2, Faris Pond; pond no. 3, Fees Pond; pond no. 4, Monon Pond.

Spirogyra varians is the most widely distributed alga found in this region. It grows under varied conditions. It conjugates at all seasons of the year, depending on hard external conditions, *e. g.*, the drying up of a pond.

Chaetophora thrives best in water slightly stagnant at a temperature from 5° C. to 25° C.

Draparnaldia plumosa thrives in flowing surface-water at a temperature from 1° to 15° C.

Cladophora glomerata grows best in flowing surface-water. It persists throughout the year in the locality studied but is in a growing condition only a few weeks in the spring, while there is a brisk flow of moderately pure water.

Spirogyra nitida is the most abundant of the Conjugatae in the small stagnant ponds about Bloomington.

A CLASSIFIED LIST OF THE ALGAE FOUND, TOGETHER WITH BRIEF DATA ON THE FORMS NOT DISCUSSED ABOVE

CHLOROPHYCEAE

CONJUGATAE

Zygnemaceae

Spirogyra Link

nitida (Dillw.) Link

crassa Kütz.

varians (Hass.) Kütz.

neglecta (Hass.) Kütz. Bayou along lower part of stream no. 1, 11 Je to 1 Au '07.

Weberi Kütz.

inflata (Vauch.) Rabenh.

rivularis Rabenh. Water-works reservoir, 29 Je '07.

Zygnema Kütz.

insigne Kütz.

leiospermum De Bary

cruciatum Ag.

Mougeotia De Bary

genuflexa (Dillw.) Ag. (*Pleurocarpus mirabilis* A. Br.)

scalaris Hass.

parvula Hass.

Desmidiaceae

Closterium Nitsche

Cucumis Ehrenb. Upper part stream no. 1, 27 Je '07.

acerosum (Schrank) Ehrenb.

strigosum Bréb. Pond no. 1, 14 My '07.

Dianae Ehrenb. Pond no. 1, 15 N '06 to 10 F '07.

Ehrenbergii Menegh.

Cosmarium Corda

Botrytis Menegh. Pond no. 2, 23 N '06 to 25 Jl '07.

laeve Rabenh. Pond no. 3, 20 S '06.

pyramidatum Bréb. Water-works reservoir, 10 D '06.

Phaseolus Bréb. Pond no. 4, 8 D '06.

Docidium Bréb.

Trabecula (Ehrenb.) Naeg.

Hyalotheca Ehrenb. sp.

Staurastrum Meyen, sp.

Penium Bréb.

interruptum Bréb.

OEDOGONIALES

Oedogoniaceae

Oedogonium Link

crassiusculum Wittr.

cryptoporum Wittr.

Bulbochaete Ag.

crenulata Pringsh.

CHAETOPHORALES

Herposteiraceae

Herposteiron Naeg. sp.

Coleochaetaceae

Coleochaete Bréb.

scutata Bréb.

Ulotrichaceae

Ulothrix Kütz.

aequalis Kütz.

subtilis Kütz. Stream no. 1, 1 My '07.

zonata (W. & M.) Aresch.

Stichococcus Naeg. sp.

Chaetophoraceae

Chaetophora Schrank

pisiformis (Roth) Ag.

endiviaefolia Ag.

Myxonema Fries

nanum (Dillw.) Hazen

tenue (Ag.) Rabenh.

Draparnaldia Bory

plumosa (Vauch.) Ag.

CLADOPHORALES

Cladophoraceae

Cladophora Kütz.

glomerata (L.) Kütz.

SIPHONALES

Vaucheriaceae

Vaucheria DC.

sessilis (Vauch.) DC.

geminata (Vauch.) DC.

PROTOCOCCALES

Volvocaceae

Gonium Müll.

pectorale Müll. Stream no. 1, 10 Je '07.

Pandorina Bory

Morum (Müll.) Bory. Stream no. 1, 10 Je '07.

Pleurococcaceae

Pleurococcus Menegh.

vulgaris Menegh.

Hydrodictyaceae

Pediastrum Meyen

Boryanum (Turp.) Menegh. Stream no. 4, 10 Je '07.

Protococcaceae

Coelastrum Naeg.

microporum Naeg.

Scenedesmus Meyen

caudatus Corda. 20 Jl '07.

obtusus Meyen. Pond no. 4, 4 D '06.

Nephrocytium Naeg.

Agardhianum Naeg. Upper part stream no. 1, 27 Je '07.

Palmellaceae

Tetraspora Link

lubrica (Roth) Ag.

Gloecystis Ag.

gigas (Kütz) Lagerh. Pond no. 1, N '06 to Au '07.

HETEROKONTAE

CONVERVALES

Tribonemaceae

Ophiocytium Naeg.

bicuspidatum (Borge) Lemm. Pond no. 1, 30 Ap '07.

CYANOPHYCEAE

Nostocaceae

Nostoc Vauch.

verrucosum Vauch.

commune Vauch.

Anabaena Bory, sp.

Oscillatoriaceae

Lyngbya Ag.

ochracea (Roth) Thur. Edge of water-works reservoir, 2 N '06.

Juliana Menegh.

Oscillatoria Vauch.

tenuis Ag.

limosa (Roth) Ag.

princeps Vauch.

Phormidium Kütz.

tenue (Menegh.) Gom. Edge of pond no. 2, 14 My to 26 J '07.

incrustatum cataractorum (Naeg.) Gom. Upper part of stream no. 1, 5 Mr '07 to 1 Au '07.

Arthrospira Stizenb.

Jenneri (Kütz.) Stizenb. Edge of pond no. 4, 29 Je '07.

Rivulariaceae

Calothrix parietina (Naeg.) Thur. (*Isactis caespitosa* Wolle.)

Chroococcaceae

Merismopedia Meyen

convoluta Bréb. Pond no. 2, 27 F '07.

INDIANA UNIVERSITY, BLOOMINGTON,
INDIANA, August 1, 1907.

Some Araucarian remains from the Atlantic coastal plain *

EDWARD W. BERRY

(WITH PLATES 11–16)

The considerable theoretic importance recently assigned to the Araucarieae by some authors, coupled with their abundance and wide range during the Mesozoic and their restriction in modern floras to the South American and Australian areas, renders them a most interesting group of plants, as they are undoubtedly among the most curious and striking in appearance.

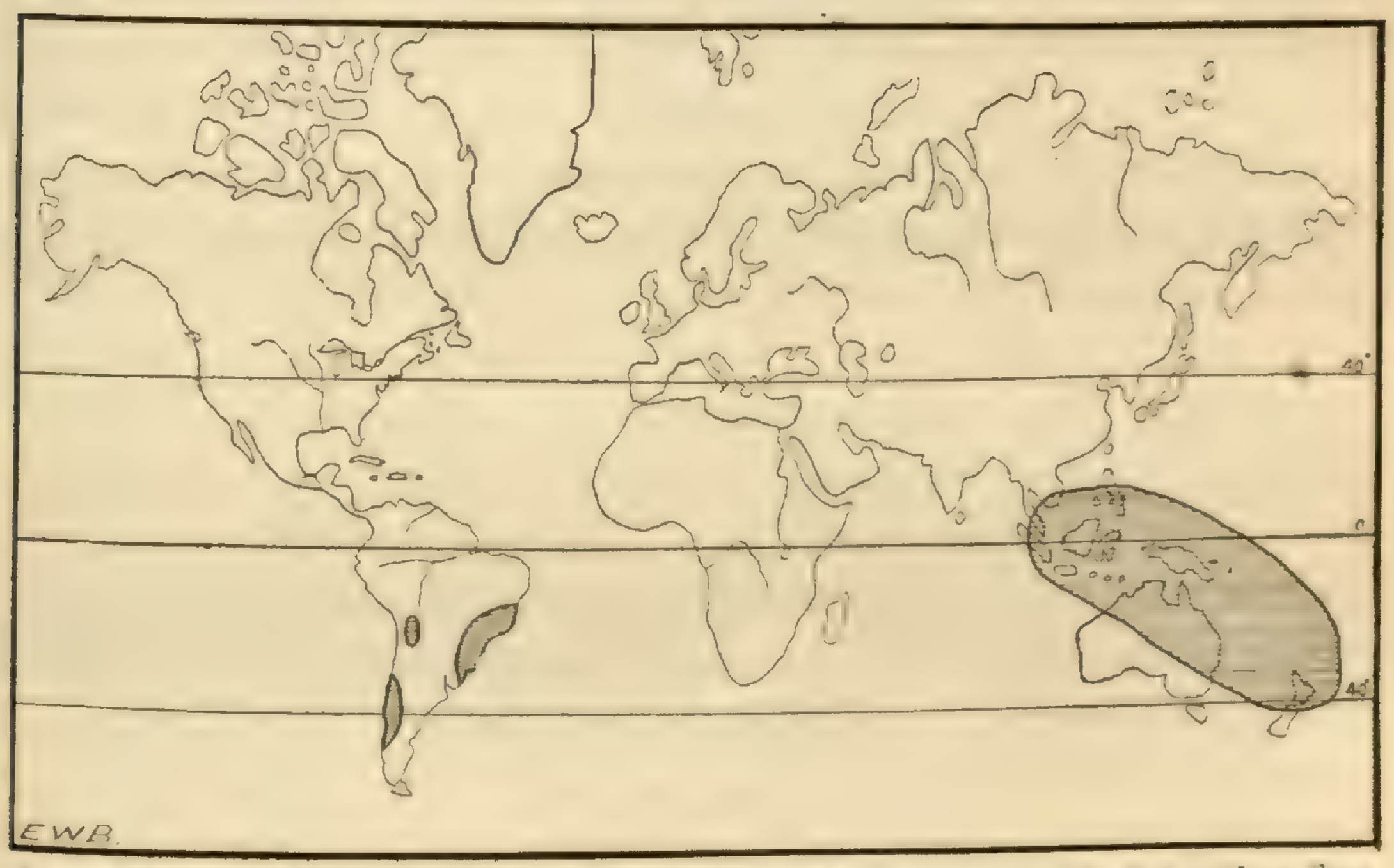


FIGURE 1. Sketch map, showing the distribution of the Araucariae in the modern flora.

The geographical distribution of the recent species is included within the lined areas of FIGURE 1. The wide extension of the oriental area is due chiefly to the genus *Agathis*, which is essentially an island type, ranging from the Philippines to New Zealand. It is to be noted that this genus does not occur in the Western Hemisphere, although during the Cretaceous rather closely allied ancestral forms (*Dammara*, *Protodammara*, and *Dammarites*)

* Published by permission of the Director of the U. S. Geological Survey.

ranged from Greenland to New Jersey and Montana. Unfortunately, the more familiar generic term for those plants, *Dammara*, is a pre-Linnean name, having been proposed by Rumphius in 1741,* so that recently systematists have taken up the name *Agathis* proposed by Salisbury in 1807.†

The genus *Araucaria* is chiefly oriental, with eight or nine species, all but one belonging to Endlicher's subgenus *Eutacta*, (1847), characterized by more or less acicular, keeled leaves and winged cone-scales. This subgenus is not represented in South America, the two or three species from that continent being referable to the subgenus *Columbea* (Salisbury, 1807), characterized by broad flat leaves, and with one species, *Araucaria Bidwilli*, in the Australian region (the "Bunya-Bunya" of southern Queensland). It will be noted also that North America, Europe, Africa, and practically all of Asia contain no representatives of this subfamily.

It is not my purpose to sketch the past history of this group, a task recently performed by Seward & Ford, who point out the probable Araucarian affinity of the Paleozoic genera *Walchia*, *Schizodendron* (*Tylodendron*), *Gomphostrobus*, and the possible Araucarian relation of the Triassic genera *Albertia*, *Voltzia*, *Ullmannia*, etc. It is, however, desirable to indicate briefly the probable range of the Araucarieae during the period when the species about to be described flourished, *i. e.*, the Cretaceous.

The recorded occurrences of Araucarieae during the Cretaceous are shown in FIGURE 2. No attempt has been made to revise these data, which may in some instances be based upon insufficient evidence, nor have obviously allied genera like *Brachyphyllum* been included, or any of the many species described as Sequoias, some at least of which would seem to be more properly referable to the Araucarieae.

By referring to the map (FIGURE 2), it will be seen that in the Western Hemisphere we have *Agathis* from 70° north latitude (Greenland), and Araucaria from 40° south latitude (Patagonia), with several species of both genera in the United States, ranging from Block Island to South Carolina on the east coast and from Montana to Kansas in the western interior. In the Eastern Hemi-

* RUMPHIUS, G. E. Herbarium Amboinense 174. Amsterdam, 1741.
† SALISBURY, R. A. Trans. Linn. Soc. Lond. 8: 312. 1807.

sphere we have records as far apart as Spitzbergen (80° North), on the one hand, and Cape Colony (30° South) on the other, with several species of both the *Araucaria* and the *Agathis* type in Europe.

The absence of Asiatic Cretaceous records is to be considered due to the lack of knowledge of Cretaceous plant beds on that continent, and not as indicative of the absence of the Araucarieae at that time.

While the distribution of the recent forms might seem to be an argument for the former existence of Antarctic land connections

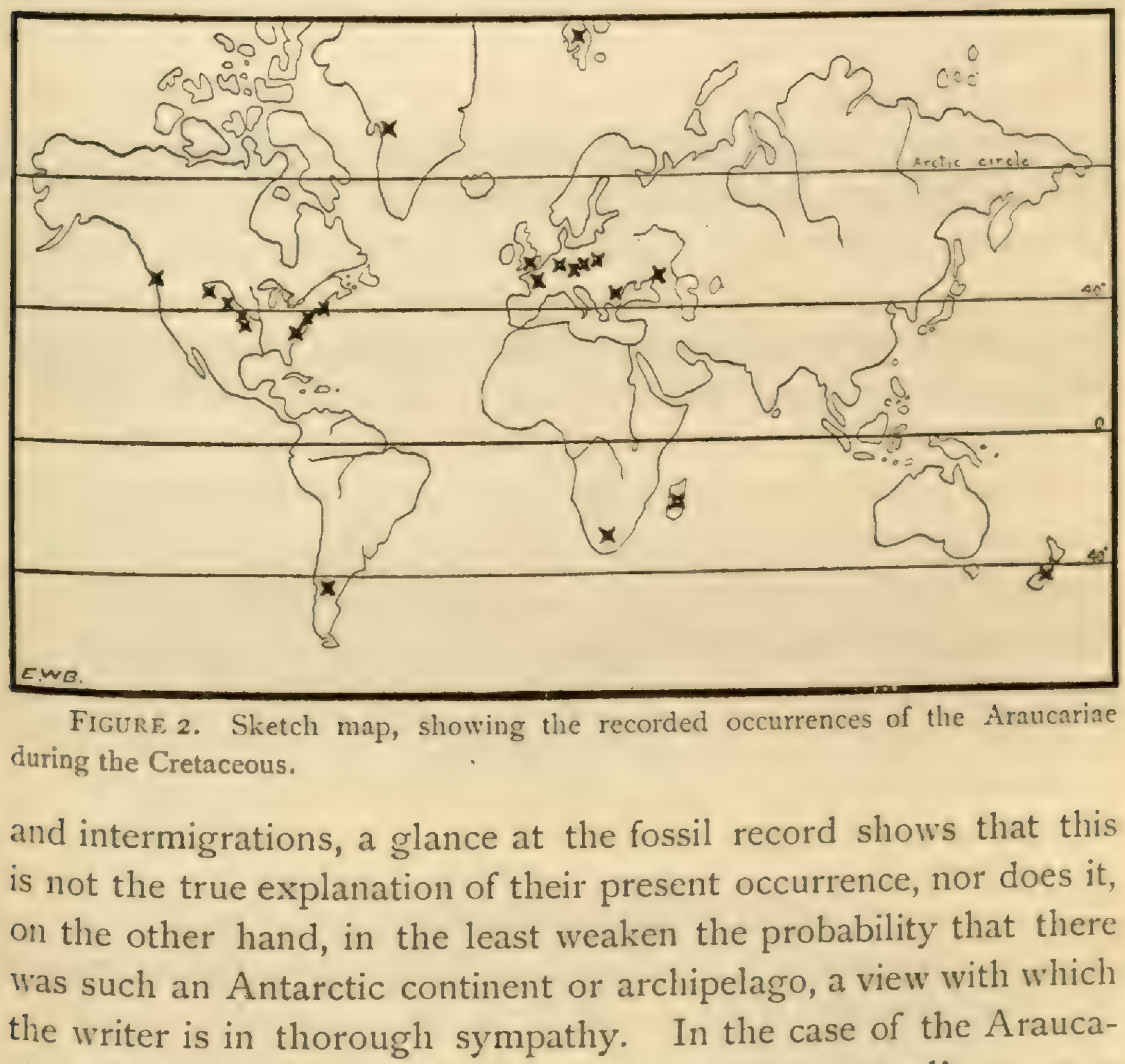


FIGURE 2. Sketch map, showing the recorded occurrences of the Araucariae during the Cretaceous.

and intermigrations, a glance at the fossil record shows that this is not the true explanation of their present occurrence, nor does it, on the other hand, in the least weaken the probability that there was such an Antarctic continent or archipelago, a view with which the writer is in thorough sympathy. In the case of the Araucarieae, however, the records show that a once cosmopolitan group has gradually become extinct in the intervening areas until its present restricted habitats are all that remain of a once world-wide dominance, a dominance which was probably reached during the later Mesozoic.

As a corollary, we would assume that the group is still

dwindling, and this is borne out not only by its much wider range in the Tertiary but by the presence of sub-fossil remains of *Agathis* in New Zealand, and of *Araucaria* in South America, in both cases showing a marked shrinkage in range in very recent times.

During the past two or three years the writer has come into possession of a considerable quantity of Araucarian remains from the Atlantic coastal plain. These are all of Mid-Cretaceous age and it seems desirable to place them on record at the present time since unquestionable remains of the genus *Araucaria* have not been previously recorded from this general region and the final treatment of these South Atlantic Cretaceous floras will undoubtedly take a long time.

The New Jersey material comes from beds of the Magothy formation, very probably of Cenomanian age. The Carolina forms are from beds which differ in age but slightly if at all from those of New Jersey, although they may be somewhat older, possibly synchronous with the Raritan formation of New Jersey and the Tuscaloosa formation of Alabama, the question of exact correlation being under active investigation at the present time.

Evidences of the abundance of the Araucarieae, using that term in a somewhat extended sense, have been emphasized recently through the studies of Hollick & Jeffrey * upon Staten Island material; and Seward & Ford † in their most admirable sketch of the recent and past history of this group have furnished good ground for the belief that the Araucarieae are the most abundant type of Coniferales in the Older Mesozoic.

Following is a brief discussion of the hitherto unknown Atlantic coastal plain species:

Araucarites Zeilleri sp. nov.

Cone a prolate spheroid, about 9 × 7 cm.; scales numerous, long, narrow, thick; cone-axis stout; details of structure obscured. (PLATE 11, FIGURE 3.)

At the first glance this looks like a very beautifully preserved Araucarian cone, but closer inspection shows that poorness of preservation has obscured nearly all of the details of structure,

* HOLLICK & JEFFREY, American Naturalist **40**: 189–216. 1906.
JEFFREY, Bot. Gaz. **44**: 435–444. *pl. 28–30.* 1907.
† SEWARD & FORD, Philos. Trans. Roy. Soc. Lond. **198 B**: 305–411. 1906.

megascopic as well as microscopic. The specimen consists of about one half of a flattened cone, diagonally fractured in a plane not greatly inclined to the longitudinal axis, the latter being hidden distally by the cone-scales and weathered away proximally.

This cone was evidently lignified in the clays and subsequently penetrated peripherally by pyrite for a distance of about 1.5 cm., which, while serving to hold together the much cracked and dessicated interior, also effectually obscures the surface features. It was found among the shingle at low tide on the beach at Cliffwood Bluff, N. J., having been washed out of a body of clay which makes the floor of the beach at this point, and was broken when found, no trace of the other half having been seen.

The specimen is 9.3 cm. long, 7.8 cm. wide at right angles to the flattening force, and 2.5 cm. thick, so that in life the cone must have been almost spherical — a slightly prolate spheroid. The scales were numerous, comparatively long and slender, and the cone-axis was very stout.

In this connection a number of fossils of a more or less doubtful nature from this locality suggest themselves as of Araucarian affinities, notable among which are the leafy twigs referred to Presl's genus *Cunninghamites*, so named for their resemblance to the existing genus *Cunninghamia*, and usually referred to the Taxodieae, although in Zittel's Handbuch (abth. 2, 1890) they are placed by Schenk in the Araucarieae. Two species have been recorded from this locality, *Cunninghamites elegans* (Corda) Endl. and *C. squamosus* Heer, both suggesting Araucarian foliage of the type found in the *Eutacta* section of the genus *Araucaria*. The broad-leaved type of foliage of the subgenus *Columbea* is probably also present at Cliffwood Bluff in the species *Araucarites ovatus* Hollick, to which I will refer on a subsequent page.

Other doubtful remains from this locality which are suggested as possibly of Araucarian affinities are the fossils denominated *Microzamia* (?) *dubia* Berry * and supposed to represent the central axis of a cycadaceous fruit-spike. This might well represent the axis of an Araucarian cone like the one under discussion, more especially as the scales are shed at maturity (in the recent species at least); the small prominence in the spirally disposed pits of the

* BERRY, Bull. Torrey Club 32: 43. *pl. 1. f. 2.* 1905.

specimen would then represent the single vascular bundle which passed into the base of the scale. This object is now refigured (PLATE II, FIGURE 1).

Another problematical fossil which may possibly belong to the Araucarieae is the cone previously described simply as "gymnospermous cone" Berry * and refigured on PLATE II (FIGURE 2). This might be a staminate Araucarian strobilus, for while most of the modern Araucarieae have greatly elongated staminate strobili, they become shortened and subcylindrical in some species, as for example in *Araucaria excelsa*, the Norfolk Island pine and more particularly in the genus *Agathis* (*Dammara*).

Araucarites Zeilleri may be compared with the cone described by Velenovsky from the homotaxial deposits (Cenomanian) of Bohemia under the name of *Araucaria bohemica*,† which is seen to be similar in appearance, and to the several species of cones of *Araucaria* and *Pseudo-araucaria* which have been described by Fliche from the Albien of France (Bull. Soc. Sci. Nancy, 171–195. *pl. 5. f. 4, 5; pl. 6. f. 2-5; pl. 7. f. 1, 2.* 1896).

Nothing similar has heretofore been collected at Cliffwood Bluff, where so many coniferous remains have been found, and it is of especial interest in coming after the recent announcement by Hollick & Jeffrey (*loc. cit.*) of two types of *Araucarioxylon* lignite from the not distant and possibly homotaxial horizon at Kreischerville, Staten Island,‡ one type which they have correlated with *Brachyphyllum* twig-impressions and with *Protodammara* cone-scales and the other more like recent Araucarian wood — which might well represent the present species — with resinous tracheids, no traumatic resin canals, and with a large pith composed mainly of tanniniferous cells. It has seemed best to use the generic term *Araucarites* as one which is of broader significance than *Araucaria*, since the preservation of the cone is such that it might equally well be considered as a Mid-Cretaceous representative of the allied genus *Agathis* (*Dammara*).

---

*BERRY, *loc. cit.* 31 : 72. *pl. 4. f. 7.* 1904.

†VELENOVSKY, Květena českého cenomanu, 8. *pl. 1. f. 20–24.* 1889.

‡The major part of the Kreischerville deposit is of Raritan age but there is some evidence that the leaf-bearing layers may be later.

Araucaria bladenensis sp. nov.

Foliage dense; phyllotaxy spiral; leaves decurrent, coriaceous, ovate-lanceolate, about 1.6 × .8 cm., the base rounded, apex thickened, cuspidate; veins immersed, averaging 16 in number, straight, parallel; stomata small, in rows on ventral surface. (PLATES 12 AND 13; PLATE 14, FIGURES 1–3.)

Leaves ranging from 1 to 2.8 cm. in length by .5–1.2 cm. in width, averaging 1.6 by .8 cm., obovate in outline, with a broad rounded base narrowing abruptly and decurrent; the blade broadest about one third of the distance from the base, above which point it narrows rapidly to a thickened cuspidate tip; phyllotaxy spiral; leaf-substance represented by a thick sheet of lignite about .5 mm. thick, in which the veins are immersed. These veins average 14 to 16 in number, although occasionally there may be as many as 20; they are stout, incurved at the base (forking not observed), becoming parallel and running directly upward until they abut against the leaf margin, *i. e.*, not convergent toward the tip of the leaf. When this species was first collected it was thought that it might be sufficiently well preserved to show the internal structure when studied by the admirable methods devised by Professor Jeffrey for treating more or less refractory remains of this sort. Professor Jeffrey, who has been good enough to examine some of these leaves for me with this end in view, writes that in spite of their hopeful megascopic appearance their microscopic structure is not preserved.

In one or two instances where the specimens are in a more argillaceous matrix it has been possible to get rather inferior specimens showing the arrangement and outlines of the stomata (PLATE 14, FIGURE 3). These are broadly ovate in shape with very thin guard cells (at least when viewed on the surface). They are arranged in somewhat irregular rows on the ventral surface of the leaf, the number of rows between the two veins being usually four. Aside from the foregoing facts, the preservation is such that no other details can be made out.

This species is most remarkably similar to the recent *Araucaria Bidwilli* of the Australian region, a twig of which, kindly furnished by the New York Botanical Garden, has been photographed and introduced on PLATE 15 for comparison. The resemblance is even closer than the reproductions indicate, a dried herbarium specimen

of the latter and a twig of the former preserved as a brownish impression in the Rockfish Creek clays being practically indistinguishable. This resemblance in form, habit, and stomatal characters, reinforced by the occurrence of characteristic Araucarian conescales in the same beds at certain localities, renders the identification reasonably conclusive.

A wide comparison has been made with other and similar fossil remains of Mesozoic age. The most nearly related form seems to be *Araucarites ovatus* (PLATE 14, FIGURES 4, 5) described by Hollick * from the Cliffwood clays of New Jersey, which differ merely by their larger size, absence of basal characters, and much less pointed tips; in fact, if the two were found in closer association or if in the abundant Carolina material any specimens had approached *Araucarites ovatus* in size I would be disposed to consider them as the variants of a single species. As the case stands, it seems better to institute a new species, since the leaves in the Carolina material are sufficiently and uniformly different enough to be readily recognized, and there is the further possibility that the New Jersey species may be more or less closely related to the modern genus *Agathis* (*Dammara*) rather than to *Araucaria*.

A genus which was at once suggested for comparison was the genus *Nageiopsis* of Fontaine, the real botanical position of which is so uncertain. It is true that Fontaine characterizes the leaf-arrangement as distichous or subdistichous, but this is the ordinary habit of numerous conifers with a spiral phyllotaxy and one which would be emphasized in fossil remains preserved as impressions. There is some resemblance to *Nageiopsis ovata* Font.† from the Older Potomac of Virginia. However, an examination of the type material in the U. S. National Museum demonstrates the distinctness of the Carolina species, as it does also the exceedingly inaccurate figures of Fontaine's monograph. Another of this author's species which is somewhat similar is *Nageiopsis montanensis*, described from the Kootanie of Montana, ‡ but since it is founded on a single specimen and there are no features which indicate that

* HOLLICK, Trans. N. Y. Acad. Sci. **16**: 128. *pl. 12. f. 3a, 4.* 1897.

† FONTAINE, U. S. Geol. Surv. Monog. **15**: 199. *pl. 77. f. 4; pl. 80. f. 5.* 1889.

‡ FONTAINE, *loc. cit.* **48**: 312. *pl. 73. f. 10.* 1906.

it really is a *Nageiopsis*, it is not worth considering further in this connection.

A European form which must surely be considered as a nearly related congener of *Araucaria bladenensis* is Saporta's *Araucaria Toucasi* described from the Turonian of Beausset near Toulon, France.* This is strikingly similar to the Carolina species in every respect and likewise closely allied, in appearance at least, to the recent *Araucaria Bidwilli* of Australia.

Kerner† records *Pachyphyllum* (*Pagiophyllum*) *rigidum* Saporta and *Pachyphyllum* (*Pagiophyllum*) *araucarinum* Saporta from the Cenomanian of Lesina, an island in the Adriatic off the coast of Dalmatia, both being originally Jurassic species from the French Corallien of Verdun‡. Both are very similar to the Carolina species and are of about the same age. The probable identity of Cenomanian and Corallian species, it seems to me, is extremely doubtful, and both of Kerner's species should undoubtedly be considered as new species of Araucaria and nearly related, if not identical, with such Mesozoic forms as *Araucaria bladenensis* or *Araucaria Toucasi*.

Other fossil remains which deserve to be mentioned in this connection and which may really be Araucarian, although abundantly distinct from this Carolina species, are *Podozamites? acutus* Saporta§ from the Neocomian of Portugal, whose resemblance to *Nageiopsis ovata* and *N. zamioides* is noted by Saporta; and *Podozamites lanceolatus* (L. & H.) F. Braun forma *elliptica* Möller from Bornholm‖ which is scarcely to be distinguished from *Nageiopsis montanensis* Font. from the Kootanie; and *Pagiophyllum* sp. Dawson¶ from the Kootanie of Canada.

Araucaria bladenensis occurs abundantly as detached leaves in the Cretaceous dark-drab, very lignitic clays, at numerous localities in the south Atlantic Coastal plain, and occasionally as twigs of considerable size showing phyllotaxy and other characters. It is preëminently the type fossil of the Bladen formation of North Caro-

* SAPORTA, Le Monde des Plantes 198. *f. 27.* 1879.
† KERNER, Jahrb. k.k. Geol. Reichsanst. 45: 49. *pl. 4. f. 3*; 50. *pl. 4. f. 1*
‡ SAPORTA, Plantes Jurassiques, Paléont. Franc., Végétaux, *pl. 177, 178.*
§ SAPORTA, Fl. Foss. Portugal 87. *pl. 16. f. 28.* 1894.
‖ MÖLLER, Kongl. Sv. Vet.-Akad. Handl. 36⁶: 8. *pl. 7. f. 9.* 1903.
¶ DAWSON, Trans. Roy. Soc. Can. 10¹: 90. *f. 14.* 1892.

lina,* single leaves or even fragments being quite characteristic and easy of recognition. Discovered originally in material collected at Parker Landing by Dr. L. W. Stephenson in 1906, it has since been found in a large number of outcrops of this formation in this same general region.

Following are the localities from which it is known at the present time:

NORTH CAROLINA: Parker Landing, Tar River (abundant); 95½, 92, 87⅝, and 87½ miles above Newbern, Neuse River; Big Bend (abundant), Sykes Landing, Clear Run, Corbits (Old Union) bridge, A. C. L. R. R. bridge, Horrel Landing, and 74¾ miles above Wilmington, Black River; Rockfish Creek, near Hope Mills (abundant); mouth of Harrison's Creek, Cape Fear River.

SOUTH CAROLINA: 3 to 4 miles northeast of Florence.

ALABAMA: 2 miles south of Havana in Hale County.

Araucaria Jeffreyi sp. nov.

Cone-scales deciduous, rhomboidal, straight-sided, thin-margined, the apex broadly rounded, with long central apical spur; scales divided by transverse furrow into "ligule" and scale proper, single-seeded. (PLATE 16.)

This species is represented by a considerable number of large single-seeded cone-scales preserved as impressions and associated with *Araucaria bladenensis* at Big Bend and A. C. L. R. R. bridge on the Black River, at 92 and 87⅝ miles above Newbern on the Neuse River and at Parker Landing on the Tar River, all localities in North Carolina. The latter specimens differ somewhat from the others and approximate more nearly the shape of the foliage leaves of *Araucaria bladenensis*, but since the scales from the former locality are somewhat variable, as indeed they are from different positions on a single modern Araucarian cone, it seems likely that they all belong to one species of cone.

The scales are rhomboidal, the thin lateral margins straight to the point of greatest width, then more or less rounded, produced medianly into a long and narrow point. This point is over a centimeter long in two specimens which still lack the terminal portion. In some specimens the scales are obviously divided by a

* STEPHENSON, Johns Hopkins Univ. Circulars, II. 1907 [7]: 95. 1907.

transverse furrow into the scale proper and the so-called "ligule." This feature is not shown in FIGURES 10 and 11, which probably represent the transitional phase between functional scales and foliage leaves toward the base of the cone, while the additional variations in the specimens figured are probably likewise correlated with the regions of the cone from which they came. They are all preserved as impressions with fragments of lignite representing the scale-substance. With the exception that they do not appear to have been as thick, they are strictly comparable with the typical scales of *Araucaria Bidwilli*. In general outline they are also comparable with the scales of *Araucaria Cookii* of the *Eutacta* section of the genus. Although no seeds have been found as yet in the Carolina material, it seems likely that they will eventually be discovered. From the structure as disclosed in the present impressions it seems obvious that the scales were single-seeded as in the modern genus, and, taken in conjunction with the foliage just described as *Araucaria bladenensis*, they furnish conclusive evidence of the abundant presence in the Mid-Cretaceous of eastern North America of true Araucarieae, thus still further increasing the parallel between the Mid-Cretaceous floras of this country and those of Europe.

Many remains of cones and cone-scales have been described as species of Araucarieae but it seems scarcely worth while to enumerate them in this place. Some have already been mentioned under *Araucarites Zeilleri*, and for others the reader is referred to the monograph of Seward & Ford (*loc. cit.*).

JOHNS HOPKINS UNIVERSITY,
BALTIMORE, MD.

Explanation of plates 11-16

PLATE 11

FIG. 1. *Microzamia* (?) *dubia* Berry. A possible Araucarian cone-axis, Cliffwood, N. J.

FIG. 2. Gymnospermous cone, Berry. A possible Araucarian staminate cone, Cliffwood, N. J.

FIG. 3. *Araucarites Zeilleri* Berry, sp. nov. Cliffwood Bluff, N. J.

PLATE 12

Araucaria bladenensis Berry, sp. nov.

FIGS. 1–3. Rockfish Creek, N. C.

FIG. 4. Horrel Landing, N. C.

PLATE 13

Araucaria bladenensis Berry, sp. nov. Showing form of detached leaves and their usual method of occurrence. Parker Landing, N. C.

PLATE 14

FIGS. 1, 2. *Araucaria bladenensis* Berry, sp. nov. Showing closely imbricated leaves at the fork of a branch. Parker Landing, N. C.

FIG. 3. *Araucaria bladenensis* Berry, sp. nov. Showing form and arrangement of the stomata, enlarged about 20 times. Rockfish Creek, N. C.

FIGS. 4, 5. *Araucarites ovatus* Hollick. Introduced for comparison. (After Hollick.) Cliffwood Bluff, N. J.

PLATE 15

Araucaria Bidwilli Hook. From a photograph (natural size) of an herbarium specimen. Introduced for comparison. Photograph by E. H. Sapp.

PLATE 16

Araucaria Jeffreyi Berry, sp. nov.

FIGS. 1–9, 12. Big Bend, N. C.

FIGS. 10 11. Parker Landing, N. C

Notes on Carex — IV

Kenneth Kent Mackenzie

Carex phaeocephala Piper

Carex leporina var. *Americana* Olney, Proc. Am. Acad. Arts & Sci. 8 : 407. 1872 (name only). — Bailey, Proc. Am. Acad. Arts & Sci. **22** : 152. 1886.

"*Carex leporina* L." Bailey, in Coulter, Man. 396. 1885.

"*Carex Preslii* Steud." Bailey, Mem. Torrey Club **1** : 52. 1889.

"*Carex petasata* Dewey;" Holm, Am. Journ. Sci. IV. **16** : 20. 1903.

Carex phaeocephala Piper, Contr. U. S. Nat. Herb. **11** : 172. 1906.

Clumps from medium-sized to large, strongly cespitose, the rootstocks densely matted, the culms 1–3 dm. high, exceeding the leaves, obtusely angled below, sharply angled and more or less roughened above. Leaves three to six to a culm, clustered towards the base, the sheaths much overlapping, whitish-hyaline towards apex opposite the blades, the blades short, more or less involute, ascending to recurving, 1.5–2 mm. wide, usually 5–15 cm. long, roughened towards the apex; spikes two to five (rarely seven) aggregated into an erect head 12–25 mm. long, 5–12 mm. wide, the lower one or two spikes occasionally a little separate, the spikes ovate to oblong, 6–12 mm. long, 5–8 mm. wide, obtuse at apex, narrowed and often quite clavate at base (especially the uppermost), the perigynia usually 10–20, appressed-ascending, the beaks inconspicuous, the staminate flowers basal, inconspicuous; lower bracts occasionally developing a short cusp, the upper scale-like; scales ovate, acute, dark-brownish or brownish with lighter midrib and broad hyaline margins, as wide and as long as the perigynia; perigynia oblong-ovate, flat, plano-convex, distended over the achene, 4.5 mm. long, 1.8 mm. wide, winged, round-tapering at base, strongly nerved on outer surface, nearly nerveless or lightly nerved on the inner, the body abruptly contracted into the beak, which is 1 mm. long, rather minutely bidentate and serrulate on the margins; achenes lenticular, brownish, obovate-oblong, 1.5 mm. long, 1 mm. wide; stigmas two.

This species, which is closely related to *Carex leporina* L., and represents it in the Rocky Mountain region, has been known under

different names for many years, but has never been fully described. Collections made during the last ten years have much extended our knowledge of the plant, and have shown that it has a wide range, and is one of the characteristic species of the alpine summits of the Rockies. The chief distinctions between it and *C. leporina* may be contrasted as follows:

Culms 1–3 dm. high, the leaves bunched near base; blades 1.5–2 mm. wide, more or less involute. *C. phaeocephala.*

Culms 1.5–4 dm. high, the leaves not bunched; blades 2–3 mm. wide, flat. *C. leporina.*

Two names have been ascribed to this species at different times, but neither of them can properly be used.

1. *Carex Preslii* Steud. Plant. Cyp. 242. 1855. The author of this species based his description on Presl's *C. leporina* L. (Reliq. Haenk. 204. 1830). His description can be applied to several North American species of *Carex* found in the Nootka Sound region, where the plant was obtained, and to apply it to the present plant is pure guess-work. It is to be noted, too, that he does not place the species next to *Carex leporina*, which was, of course, well known to him, but in a section "species quoad sectiones et affinitatem minus notae, partim omnino dubiae." The original specimen seems to have disappeared (Bailey, Mem. Torrey Club 1: 52), and, in any event until it is located, the name should be disregarded.

2. *Carex petasata* Dewey, Am. Jour. Sci. I. 29: 246. 1836. As this is one of the earliest published species of *Carex* from the Rocky Mountain region its identification is important. Of it Professor Bailey says: "The original sheet is in Herb. Torr. It contains three plants: *C. lagopina* Wahl., *C. festiva* Dewey, and *C. Liddoni* Boott, to all of which Dewey's description will equally apply" (Mem. Torrey Club 1: 52). Concerning this I should say that the description calls for a plant with a "compressed," "slightly winged" perigynium, characters hardly applicable to *C. lagopina*, and as Dewey described *C. festiva* in the same paper we can hardly refer *C. petasata* to it. The facts concerning this sheet seem to be that Drummond, the original collector, mixed *C. petasata* and *C. lagopina* (Torrey, N. Am. Cyp. 393) and that the specimen of *C. festiva* on the sheet, which was col-

lected by Nuttall, is a later addition. But finally, and most important of all, Dewey's description is accompanied by a plate (*IV. f. 72*). This plate clearly shows that it was the third plant on the sheet in the Torrey herbarium which Dewey had in mind. This plant, which I have examined, is *Carex Liddoni* Boott, as stated by Professor Bailey. As this last-named species was not published until 1840 (Hook. Fl. Bor.-Am. **2**: 214) it should be superseded by *Carex petasata* Dewey. The identification of *C. petasata* with *C. phaeocephala* rests on work done when our western *Carices* were but little known, and is entirely baseless, so far as I know.

Of *Carex phaeocephala* I have seen the following specimens:

WYOMING: Big Horn Mts., 7000–9000 ft., *Tweedy 3344*, July–August, 1900; Sheep Mt., 11,000 ft., *Tweedy 410*, August, 1897; Teton Mts. (timber line and above), *A. & E. Nelson 6539*, August 16, 1899; Big Horn Mts., Sheridan County, 10,000 ft., *Tweedy 2240*, August, 1899; Anita Peak, Routt County (alpine grassy summits), *Goodding, 1754*, August 3, 1903; Ethel Peak, Larimer County, *Goodding 1900*, August 14, 1903.

COLORADO: Bottomless Pit, 3800 m., *F. E. & E. S. Clements 501*, July 23, 1901; Windy Point, Pike's Peak, *Clements 3*, 1900; "Rocky Mts.," *Vasey 600*.

UTAH: Belknap Peak, *Rydberg & Carlton 7361*, July 28, 1905; Bear River Canyon, 11,000 ft., *Watson 1234*, August, 1869.

MONTANA: Long Baldy, Little Belt Mts., 7000 ft., *Rydberg 3399* and *3400*, and *Flodman 312*, August 19, 1896; Old Hollowtop (near Pony), 9000 ft., *Rydberg & Bessey 3783*, July 7, 1897; Columbia Falls, *Williams*, September 8, 1892; Spanish Peaks, Madison Range, 7000–8000 ft., *Flodman 323*, July 14, 1896; Spanish Basin, *Rydberg 3066*, July, 1896; Mt. Henry, Midvale, *Umbach 408*, July 16, 1903; near Glacier Basin, 2200 m., *Vreeland 1085*, August 5, 1901 (blades but 1 mm. wide).

IDAHO: Mt. Chauvet, 10,000 ft., *Rydberg & Bessey 3782*, July 29, 1897.

WASHINGTON: Mt. Adams, *Howell, 3900*, August, 1882.

OREGON: Mt. Hood, *Lloyd*, July 21, 1894, and *Henderson* (alpine moraines), July 20, 1884; head of Wallowa River, 9000 ft., *Cusick 2479*, July 17, 1900.

CALIFORNIA: Mt. Shasta, 10,400 ft., *Copeland 3568*, July 16, 1903.

CANADA: Selkirks, 7,500 ft., *Shaw 1020*, July 26, 1905; Selkirks, 8000 ft., Heights above Carbonate Draw, *Petersen*, July 14, 1904; Lake O'Hara, Rocky Mt. Park, 7500 ft., *John Macoun 64016*, August 9, 1904; Lake Louise, Rocky Mts., 7300 ft., *John Macoun 64017*, July 20, 1904; Old Glory Mt., 6500 ft., between Kettle and Columbia Rivers, *J. M. Macoun 63324*, August 13, 1902.

Carex projecta sp. nov.

"*Carex cristata* Schwein." Kunze, Car. *pl. 44. f. g.* 1840–1850. — Boott, Ill. Car. 117, in part, *pl. 373.*

Carex lagopodioides var. *moniliformis* Olney, Exsicc. fasc. 2, no. 8 (n.n.); Bailey, Bot. Gaz. **10**: 380. 1885.

"*Carex tribuloides moniliformis* (Tuckerm.) Britton;" Britt. & Brown, Ill. Fl. **1**: 356. 1896. Not *Carex scoparia* var. *moniliformis* Tuckerm.

Carex tribuloides var. *reducta* Bailey, Proc. Am. Acad. Arts & Sci. **22**: 148. 1886. Not *Carex reducta* Drejer.

Clumps small to medium-sized, not stoloniferous, the culms 5–9 dm. high, exceeding the leaves, strongly roughened on the angles beneath the head. Leaves with well-developed blades usually four to six to a fertile culm, on the lower half but not clustered, the sheaths long and loose, the ligule not prolonged, the blades flat, 3–7 mm. wide, usually 2–4 dm. long, roughened especially on the margins and towards the apex; sterile culms very leafy; spikes eight to fifteen, alternately and usually loosely arranged in a flexuous moniliform head 3–5 cm. long, less than 1 cm. broad, the spikes orbicular or suborbicular, 5–8 mm. long, 4–7 mm. wide, straw-colored or greenish or even brownish, blunt at the apex, subclavate-tapering at base, the staminate flowers basal, few, but their scales rather conspicuous, the perigynia 15–30, ascending-spreading, with conspicuous often widely divergent beaks; lower bract (when developed) setaceous and much shorter than the head; upper bracts scale-like; scales lanceolate or ovate-lanceolate, obtuse to acutish, straw-colored with hyaline margins, often brownish-tinged, narrower and much shorter than the perigynia; perigynia straw-colored or brownish, lanceolate, flat, more or less strongly distended over the achene, noticeably but narrowly wing-margined to the base, 3.25–5 mm. long, about 1.5 mm. wide, nerved on both surfaces, round-tapering at base, tapering into the serrulate bidentate beak, which is one third to one half the whole length; achenes lenticular, short-stipitate, 1.5 mm. long, 0.5 mm. wide, oblong; stigmas two.

This plant is so widely distributed and well marked that it seems to me to be fully entitled to specific recognition. The flexuous head and the small spikes, with the perigynia-beaks conspicuous and widely divergent, present a marked contrast to the stiffer head, the larger spikes, and the appressed perigynia-beaks of *Carex tribuloides* Wahl., its nearest ally. It ranges from Nova Scotia and New Brunswick to Minnesota and south to the District of Columbia and Illinois, but is rare in the southern part of its range. The following specimens have been examined by me:

NOVA SCOTIA: Pictou, *Howe & Lang 459*, July 12, 1901.

NEW BRUNSWICK: Kouchibougnac, *Fowler*.

QUEBEC: Montmorenci Falls, *John Macoun 67783* and *67784*, July 7 and June 28, 1905; Rivière du Loup, *Eggleston 3065*, August, 1902.

MAINE: Ft. Kent, *Knight*, August 20, 1905; Beech Hill Road, Mt. Desert Island, *Faxon*, July 4, 1892; Orono, *Briggs*, September, 1892, and *Fernald*, July 7, 1891; Ft. Fairfield, *Fernald 162*, July 6, 1893.

NEW HAMPSHIRE: "State Line," *Brainerd*, July 16, 1896; White Mountains, *Tuckerman*.

VERMONT: Rutland, *Eggleston 2492*, July 23, 1901.

NEW YORK: Adirondack Mts., *Peck*.

ONTARIO: North Bay, Lake Nipissing, *Fowler*, July 18, 1891; Guelph, *Klugh*, July 25, 1905; Ottawa, *John Macoun 26856*, June 26, 1900.

MINNESOTA: Milaca, Mille Lacs Co., *Sheldon*, July, 1892.

ILLINOIS: Athens, Menard County, *E. Hall*, June, 1870.

DISTRICT OF COLUMBIA: *Steele*, June 3, 1900.

✓ **Carex chihuahuensis** sp. nov.

Clumps medium-sized, the rootstocks long-creeping, culms 2–3 dm. high, filamentose at base, strict, slightly roughened on the angles, exceeding the leaves. Leaves with well-developed blades four to eight to a fertile culm, clustered on the lower fourth, the sheaths overlapping, the ligules not prolonged, the blades flat, ascending, 2–3 mm. wide, 5–15 cm. long, very rough towards the apex; inflorescence consisting of numerous scarcely distinguishable spikes densely aggregated (or the lower clusters separate) into a compound or somewhat decompound ovate or oblong head, 2–7 cm. long, 7–15 mm. wide, the individual spikes with 4–10 as-

cending or more or less spreading perigynia below and the inconspicuous staminate flowers above; bracts scale-like, the lower prolonged, shorter than the head; scales ovate-oblong, obtuse (or lower acute), light-brownish with straw-colored midrib and hyaline margins, about the width of the perigynia but shorter; perigynia ovate, plano-convex, thick and corky at base, 3.5 mm. long, 1.5 mm. wide, the edges sharp-angled but not winged, nerved on outer, nerveless on inner surface, at maturity round-truncate at base (the young perigynia rounded), tapering at apex into the serrulate bidentate beak, this $\frac{1}{4}$–$\frac{1}{3}$ the length of the whole (or longer in the young perigynia); achene lenticular, occupying upper half of perigynium body, sessile, oval, 1.5 mm. long, 1 mm. wide; stigmas two.

This is one of the numerous forms at various times referred to *Carex marcida* Boott. The most satisfactory point of distinction between the two species is that the present species has the body of the perigynium corky at base, with the achene in the upper part, while in *C. marcida* the perigynium body is not corky at base and the achene is inserted in the lower part of the body.

Specimens examined:

CHIHUAHUA, MEXICO: Puerta de St. Diego, 6500 ft., *C. V. Hartman 620*, April 12, 1891 (type in herb. N. Y. Bot. Garden); Sierra Madre near Colonia Garcia, 7800 ft., *Townsend & Barber 19*, June 7, 1899.

CAREX SCIRPOIDEA MICHX. AND ITS ALLIES

Among the most widely distributed of the Canadian species of *Carex* is the well-known *Carex scirpoidea* Michx. Found in mountainous country, it ranges from the Gaspé region to the Canadian Rockies and northward to Alaska, and in the United States it occurs in many places in the extreme north — for example, in Maine, New Hampshire, Vermont, and Montana. In the eastern part of its range it has no near relatives, but in western Canada and the northwestern part of the United States, it is either wholly or largely supplanted by certain allied species, several of which have a much more southern range than *Carex scirpoidea* itself.

Of the five allied species which I have been able to recognize, one — *Carex pseudoscirpoidea* Rydberg — has been carefully described by its author; two others — *Carex stenochlaena* (Holm) and *Carex gigas* (Holm) — have been published as varieties of

Carex scirpoidea; and two others — *Carex scabriuscula* and *Carex scirpiformis* — are here proposed as new.

In addition to valuable characters derived from the shape and color of the perigynium and its pubescence or relative lack of pubescence, the chief points connected with the inflorescence to be noticed are the shape, relative length, and pubescence of the scales. The width of the leaf-blades and the relative stoutness of the culms, although at times relied on, are too variable to be of real service, and while the western allies of *C. scirpoidea* as a whole seem much more inclined to grow in dense mats and to have shorter dense rootstocks than that species I am not able to judge from herbarium material alone whether this character can be relied on.

However, there is another character which Mr. Holm has used in other groups of *Carex* and seems to be constant and of value in the present group. That is, in some of the species the lower culm-leaves are reduced to bladeless sheaths, thus leaving in the present group but few (usually 3–5) well-developed leaves to a culm; and in other species the lower culm-leaves develop blades, thus giving in the present group many (usually 6–10) well-developed leaves to a culm. The former species are referred to as aphyllopodic; the latter as phyllopodic. One of the best marks of distinction of *Carex pseudoscirpoidea* is that it is phyllopodic, and this is also true of the very local *Carex gigas* and *Carex scabriuscula*. On the other hand the other three species are aphyllopodic.

The following key will serve to distinguish the species and to contrast their more evident points of difference:

Perigynium sparsely pubescent towards apex only, dark brownish-black.
  Perigynium-body broadly oval, 3 mm. long, very abruptly beaked. — *C. gigas.*
  Perigynium-body lanceolate, 4 mm. long, tapering into the beak. — *C. scabriuscula.*

Perigynium densely pubescent to hirsute, lighter in color (or dark at apex only).
  Perigynium lanceolate, flattish, 4 mm. long. — *C. stenochlaena.*
  Perigynium broader, triangular, 3 mm. long or less.
    Culms aphyllopodic, the culm-leaves usually 3–5; scales shorter than perigynia.
      Scales very minutely hyaline-margined; perigynium whitish-pubescent. — *C. scirpoidea.*

Scales very broadly hyaline-margined; perigynium yellowish-hirsute.	*C. scirpiformis.*
Culms phyllopodic, the culm-leaves usually 6–10; scales concealing perigynia.	*C. pseudoscirpoidea.*

Descriptions of the new species and the varieties here raised to specific rank follow:

Carex gigas (Holm) sp. nov.

Carex scirpoidea var. *gigas* Holm, Am. Journ. Sci. IV. **17**: 21. 1904.

Culms 3–4.5 dm. high, phyllopodic, from densely matted stout rootstocks, the culms stoutish, roughened on the angles above, much exceeding the leaves, reddened and somewhat filamentose at base. Leaves with well-developed blades 5–10 to a fertile culm, clustered near the base, the sheaths hyaline opposite the blades, brownish-tinged and minutely puberulent, the blades ascending, flat, 2.5 mm. wide, 5–15 cm. long, roughened towards the apex; culms dioecious, the spike erect, normally solitary; staminate spike not seen, the pistillate (terminal) linear, 1.5–2.5 cm. long, 4–6 mm. wide, with an ovate short-pointed scale-like bract at base, and an elongated (2–4 cm. long) bract 1–3 cm. below, its sheath slightly darkened and little (1–3 mm.) sheathing, often with a smaller peduncled spike in its axil; scales oblong-ovate, glabrous, brownish with lighter midrib and narrow hyaline margin, acute or obtuse, as wide as the perigynia and of about the same length; perigynia numerous, black, 3 mm. long, 2 mm. wide, the body broadly oval, flattish, rounded at base, rounded at apex and very abruptly contracted into the minute bidentate beak (0.5 mm. long), minutely puberulent above and pubescent on the angles; achenes triangular, 2 mm. long; stigmas three.

This species, as yet known only from northern California, has a perigynium entirely different from that of any other member of this group, and is clearly entitled to be treated as a species.

Specimens examined:

CALIFORNIA: Siskiyou County, 8,000 ft., *Pringle*, August 18, 1881.

Carex scabriuscula sp. nov.

Culms about 3 dm. high, phyllopodic, from stout short-creeping rootstocks, the culms stoutish, roughened on the angles above, much exceeding the leaves, somewhat reddened at base. Leaves with well-developed blades 5–10 to a fertile culm, clustered near the base, the sheaths hyaline, brownish-tinged and minutely puberulent towards the apex opposite the blades, the blades ascending, flat, 2–3 mm. wide, 6–12 cm. long, roughened towards the apex; culms dioecious, the spike erect, normally solitary; staminate spike

not seen, the pistillate (terminal) linear, 1.5–4 cm. long, 4–8 mm. wide, with an ovate short-pointed scale-like bract at base, and an elongated (2–4 cm. long) bract 1–3 cm. below, its sheath somewhat darkened and scarcely sheathing, often with a small peduncled spike in its axil; scales oblong-ovate, glabrous, brownish-black with lighter midrib and narrow hyaline margins, acute or obtuse, as wide as the perigynia but shorter; perigynia numerous, black, 4–4.5 mm. long, 1.5 mm. wide, the body lanceolate, flattish, rounded at base, tapering at apex into the minute entire (or nearly entire) beak (0.5 mm. long), minutely puberulent and pubescent on the angles above; achenes triangular, 2 mm. long; stigmas three.

The perigynium in this plant is so nearly glabrous in age that at a first glance it appears completely so, and this lack of apparent pubescence gives the species a very different aspect from that of *C. scirpoidea*.

Specimens examined:

"Casçade Mountain Plants," wet meadow of the Cascade Mts., *Cusick 2849*, June 30, 1902. (Type in herb. N. Y. Bot. Garden, distributed as *Carex feta* Bailey.)

Carex stenochlaena (Holm) sp. nov.

Carex scirpoidea var. *stenochlaena* Holm, Am. Journ. Sci. IV. **17**: 20. 1904.

Culms 2.5–4 dm. high, aphyllopodic, from densely matted stout rootstocks, the culms stoutish, strongly roughened on the angles above, much exceeding the leaves, reddened and somewhat filamentose at base. Leaves with well-developed blades usually 3–6 to a fertile culm, on the lower third but not clustered, the sheaths long-overlapping, hyaline, brownish tinged and puberulent opposite the blades, the blades ascending, flat, 2–2.5 mm. wide, 5–15 cm. long, roughened towards the apex; culms dioecious, the spike erect, solitary; staminate spike 2 cm. long, 3–5 mm. wide, the scales obtuse, brownish with lighter center and hyaline margins, the pistillate linear, 1.5–3 cm. long, 4–7 mm. wide, with an elongated bract 0.5–5 cm. long, inserted 0.5–3 cm. below, its sheath dark-colored, little sheathing; scales oblong-ovate, puberulent and slightly ciliate at apex, black with midnerve lighter and a very narrow hyaline margin, acute or obtuse, as wide as perigynia but somewhat shorter; perigynia numerous, black (at least towards apex), 4 mm. long, 1.5 mm. wide, the body lanceolate, flattish, rounded at base, tapering at apex into the minute entire beak 0.5 mm. long, appressed-pubescent; achenes triangular, 2 mm. long; stigmas three.

Apparently this species is the most common representative of

the group near the Pacific coast. Its oblong-ovate black scales and long (4 mm.) lanceolate perigynia readily distinguish it.

Specimens examined:

BRITISH COLUMBIA: Chilliwack Valley, 4000 ft., *J. M. Macoun 33,728*, July 12, 1901.

ALASKA: On bluffs along Yes Bay, *Howell 1705 A*, July 16, 1895.

WASHINGTON: Horse-Shoe Basin, Okanogan County, 5000 ft., *A. D. E. Elmer 684*, September, 1897.

Carex scirpiformis sp. nov.

Culms 2.5–4.5 dm. high, aphyllopodic, from matted or short-creeping slender or stoutish rootstocks, the culms from slender to stout, strongly roughened on the angles above, much exceeding the leaves, reddened at base. Leaves with well-developed blades usually 3–6 to a fertile culm, on the lower third but not clustered, the sheaths long-overlapping, hyaline, brownish-tinged and puberulent opposite the blades, the blades ascending, flat, 2–3 mm. wide, 5–20 cm. long, roughened towards the apex; culms dioecious, the spike erect, solitary or rarely with a small additional one at base; staminate spike not seen, the pistillate linear, 2–4 cm. long, 4–5 mm. wide, with a rudimentary or elongated bract 3 cm. or less long at or somewhat below the base, its sheath somewhat darkened, little sheathing; scales ovate, strongly pubescent and ciliate at apex, brownish with broad white-hyaline margin and lighter center, obtuse or acute, as wide and nearly as long as perigynia; perigynia numerous, greenish or yellowish-brown, hirsute, 2.5 mm. long, 1.25 mm. wide, the body ovate-oval, obscurely triangular, tapering to a substipitate base, abruptly contracted at apex into the minute entire beak (0.5 mm. long); achenes triangular, 1.75 mm. long; stigmas three.

This plant is more closely related to *C. scirpoidea* than are any of the other plants here discussed. The contrast, however, between the long scales of this species with their broad hyaline margins, and those of *C. scirpoidea* with nearly no margin and usually much shorter than the perigynia, is so marked and constant in the specimens examined that I feel justified in proposing the species.

Specimens examined:

ALBERTA: Banff, damp ground near Middle Spring, 4700 ft. *McCalla 2348*, July 28, 1899. (Type in herb. N. Y. Bot. Garden); near Banff, *Macoun*, June 30, 1891 (in part); Rocky Mt. Park, *John Macoun 64054*, July 11, 1904.

The water-storing tubers of plants

JOHN W. HARSHBERGER

(WITH PLATE 17)

Recently there has been brought to the attention of the writer a number of plants that produce water-storing organs of an interesting morphologic character. They were examined in the fresh condition in free-hand sections and a number of microchemic tests were applied in order to ascertain the character of the respective reserve materials. Two species of ferns, *Nephrolepis cordifolia* from the garden of Dr. P. P. Calvert and *Nephrolepis davallioides* Kze. [*N. acuminata* (Houtt.) Kuhn] from the fernery of Mr. John P. Morris, of Chestnut Hill, were examined in detail. *Asparagus Sprengeri*, a much cultivated species of asparagus, was also studied.

Nephrolepis cordifolia (L.) Presl. [*N. tuberosa* (Bory) Willd.] is a fern which is often found in cultivation. It is easily mistaken for the sword-fern, *N. exaltata*, but it differs from that fern in having shorter fronds and the pinnules more closely crowded together. It resembles *N. philippinensis* Hort.,* also found frequently in cultivation. *Nephrolepis cordifolia* is said to occur in northern India, Japan, Australia, New Zealand, tropical east and west Africa and in the whole of tropical America, growing on the ground, as well as epiphytic on trees. It has short, thick rhizomes covered by broken-off leaf-bases and numerous strong branches are formed, some of which are developed in midsummer as fleshy tubers which are about the size of pigeon-eggs (PLATE 17, FIGURE 1). More exactly, a mature tuber measured by me was in three dimensions, twelve millimeters, twenty-eight millimeters, and three millimeters. Christ † states that these tubers store reserve products of use to the plant in its epiphytic existence. Mrs. J. M. Milligan ‡ of Jacksonville, Florida, found tubers on a specimen of

* BAILEY, in the Cyclopedia of American Horticulture, gives this (*N. philippinensis*) as probably belonging to *N. exaltata*.

† CHRIST. Die Farnkräuter der Erde, 288.

‡ MILLIGAN, Mrs. J. M. Tubers of Nephrolepis. Fern Bulletin 7: 12. 1899.

Nephrolepis, called by her *N. exaltata*, while changing the fern from one pot to another. The tubers, she says, were of all sizes up to three fourths of an inch in diameter and irregularly rounded. No indications of buds were discovered and some of the largest tubers were planted, but did not grow.

In all probability, as pointed out by J. Birkenhead,* the fern described by Mrs. Milligan as *N. exaltata* was *N. cordifolia* (= *N. tuberosa*). *Nephrolepis philippinensis* produces tubers in profusion, so also do *N. Pluma* var. *Bausei* and *N. undulata*, all deciduous ferns. A peculiar feature of these deciduous ferns, Birkenhead states, is that the plant of one season does not always grow again from the old caudex, but there is in many cases a tuber formed close to the old caudex, from which growth commences in due course the following season. The other tubers formed at various distances away from the main stem also commence growth and produce plants. One of the points which distinguish *N. pectinata* from the others, as Clute adds editorially in commenting on Birkenhead's article, is the absence of tubers. *Adiantum diaphanum* (*A. setulosum*) produces tiny tubers on its roots, the size of mustard seeds, some roots bearing twenty to thirty tubers in a length of three to four inches. Velenovsky† in his Vergleichende Morphologie der Pflanzen also describes the tubers of *Nephrolepis cordifolia* (= *N. tuberosa*).

Le Maout and Decaisne mention *Nephrodium esculentum*‡ of Nepaul that furnishes edible tubers used by the natives. Heinricher,§ in a paper published since the above statements were written by me, has presented a complete study of the regeneration of several species of *Nephrolepis* from the fleshy tubers noticed above, when these are cut and experimentally treated. He finds that tubers are formed on *N. cordifolia* Presl (= *N. tuberosa* Presl), *N. hirsutula* (Forst.) Presl, *N. Pluma* Moore, and *N. philippinensis* Hort. He distinguishes two forms of *N. cordifolia*, viz., subspecies

* BIRKENHEAD, J. Tubers of Nephrolepis. Fern Bulletin 7: 35. 1899.

† VELENOVSKY, J. Vergleichende Morphologie der Pflanzen, Teil I. Prag, 1905.

‡ I cannot find this name, but give it as a quotation.

§ HEINRICHER, E. Zur Kenntnis der Farngattung *Nephrolepis*. Flora 97: 43–73. *pl. 1, 2.* 28 D 1906. *N. Pluma* Moore is considered a variety of *N. cordifolia*.

(*a*) *tuberosa* and subspecies (*b*) *etuberosa*. The regeneration from tubers in *N. cordifolia* subsp. *tuberosa*, in *N. hirsutula*, in *N. Pluma*, and in *N. philippinensis* consists in the formation of stolons with a central axial bundle system and normal green pinnae arising from these ramentae-covered stolon-like branches. His photographic illustrations show the character of the various forms of tubers in a very satisfactory manner. Incidentally, Heinricher states that in *N. cordifolia* the tubers serve for the storage of water. In the large parenchyma-cells of the tubers of *N. hirsutula* Heinricher found small starch grains (?), which in no case completely filled the cells, and such cells reacted to Fehling's solution, indicating the presence of sugar. Sperlich likewise claims that he found the cells of young tubers filled with starch, while in the mature tubers the starch grains were sparingly found, but the sugar content had increased proportionately.

My observations on the structure of fern tubers, now to be recorded, are at variance with the above statements in the two species of *Nephrolepis* investigated by me, viz., *N. cordifolia* and *N. davallioides*. In these two ferns, the lateral cord-like branches with small hair-like ramentae are brown in color (PLATE 17, FIGURE 2). These ramentae extend also to the wrinkled surface of the tuber, but are more sparingly found. A microscopic examination of the tuber surface shows that it consists of large epidermal cells, the walls of which interlock by sinuous lines (PLATE 17, FIGURE 3). The interior of the tuber is found to consist of large, rounded hexagonal, or pentagonal parenchyma-cells, with thin walls (FIGURE 4), while the fibrovascular elements are arched near the surface, running from base to apex. These parenchymatous cells in the freshly cut tubers are filled with watery protoplasm, and the observer is impressed by the absence of solid reserve food. Considerable protoplasm with a large nucleus is present in the younger cells (FIGURE 5), but in the older cells the protoplasm and nucleus are confined to a thin wall-layer, as the sap vacuole increases in size (FIGURE 6). Treatment with iodine fails to reveal the presence of starch and protein. Water-eosin colors the protoplasm but slightly, and this reaction, as also the application of Bismarck brown, excludes the possibility of the presence of protein granules, while the use of Fehling's test for sugar gives a decided reaction, if

strong cupric sulphate is used. Absolute alcohol does not cause the deposit of inulin crystals, and the absence of inorganic crystals is very noticeable. Imbedded in the protoplasm of the cells and scattered through it are granules which suggest starch, although the iodine test fails to show its presence in the fresh tubers. To be absolutely sure that these granules were not starch grains, I applied dilute sulphuric acid, washed off the acid with distilled water, and treated the sections with iodine. No reaction took place which would indicate the presence of starch. The presence of tannin, especially in the partially mature tubers, was revealed by the action of the juice on a bright razor blade. The bluish-black discoloration produced showed the formation of tannate of iron. This test is corroborated by a microchemic reaction in which the starch-like granules take part. Tannin vesicles have been observed in various phanerogams. These tannin vesicles always arise, as Klercker has shown, in the protoplasm, from which they are most probably separated by a true precipitation membrane of albumen tannate. Whether they contain other substances than tannins cannot at present be certainly stated. Especially useful in determining the presence of tannin is Pfeffer's staining *intra vitam* with methylene-blue. In a solution of this pigment, the cell sap which contains tannin and the tannin vesicles take up the blue color. This reagent applied to thick sections of *Nephrolepis* tubers produced a blue color in the starch-like granules (FIGURE 7) which had not reacted with the application of iodine, Bismarck brown, water-eosin, sulphuric acid and iodine, and acetic acid. That this test is decisive with reference to these granules is proved, I believe, by the presence of sugar in the older tubers, such sugar having been derived from the stored tannin. It is a known chemical fact that tannin may be converted into sugar by a complex reaction, and in all probability, although I have been unable to prove it, the tannin present in the living parenchyma-cells of the above fern species is slowly transformed into sugar which reacts in the older tubers to Fehling's solution.

The character of the reserve material stored in the tubers having been determined, it can be stated definitely that water storage is the principal function of them. The amount of water stored is very considerable. If a tuber is left in the sun to dry, it loses practi-

cally all of its weight and shrivels up to a small mass of dried material, only one twenty-fifth the size of the original tuber. The observations of Goebel * are *apropos*. Goebel states that he found *Nephrolepis tuberosa* (perhaps *N. cordifolia*) as an epiphytic or terrestrial fern on the road to the Tankoban Prahoe volcano in Preanger, Java. He states that the tubers of this fern, the size of pigeon-eggs, are for the purpose of storing water, for he found that the water content was 96.3 per cent. of the total weight. He further proved this statement by placing tuber-bearing ferns in dry soil. The fronds remained green, although the water supply was extremely small. Gradually, however, the water disappeared from the tubers until they assumed a shrunken form. When grown in wet soil, the tubers retained their normal plumpness. The conclusion reached by Goebel, therefore, was that these tubers are of importance to the fern in tiding over shorter or longer periods of drought.

TUBERS OF ASPARAGUS SPRENGERI

This much-cultivated species of asparagus produces a considerable number of tuberous roots. The large secondary roots are about the thickness of a telegraph wire and on the lateral roots that grow from the larger ones occur the watery tubers † which range from twenty-five to forty-four millimeters in length and from eighteen millimeters in the larger tubers to ten millimeters in the smaller ones. They are light brown in color and almost perfectly smooth. From their distal extremity, the root is continued and this root continuation may branch and rebranch into numerous subsidiary branches.

Sections of these tubers mounted in water show large parenchyma-cells without solid contents, except in a few, small, scattered cells where bundles of raphides occur. With iodine the protoplasm which lines the cell-wall becomes yellow, and the complete absence of starch is also determined by this test. The large nuclei of these cells are also clearly shown when water-eosin is applied. These nuclei lie in the peripheral protoplasm and with the increase in size of the sap vacuole, the nucleus flattens out against the cell-wall in the thin layer of protoplasm remaining. Finally, the

* GOEBEL, K. Pflanzenbiologische Schilderungen I: 203.

† Strictly a tuber is a stem, or branch; I have used the word here in a lax sense.

nucleus disappears and the lining protoplasmic layer becomes still more contracted until it is difficult to detect. Absolute alcohol causes the contraction of the tubers, but no inulin is crystallized out by the use of this reagent. The application of Fehling's solution is without result, nor is tannin present, as the razor and methylene-blue tests indicate. Clearly, we are led to the conclusion that these tuberous roots are developed for the purpose of storing water and the necessity for the storage of this water is the same as in the fern species previously described.

UNIVERSITY OF PENNSYLVANIA.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1908)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

This Index is reprinted monthly on cards, and furnished in this form to subscribers, at the rate of one cent for each card. Selections of cards are not permitted; each subscriber must take all cards published during the term of his subscription. Correspondence relating to the card-issue should be addressed to the Treasurer of the Torrey Botanical Club.

Atkinson, G. F. Notes on some new species of fungi from the United States. Ann. Myc. **6**: 54–62. 31 Mr 1908.
Includes 27 new species.

Atwood, A. C. Catalogue of the botanical library of John Donnell Smith. Contr. U. S. Nat. Herb. **12**: 1–94. 23 Ap 1908.

Bailey, W. W. Some wild orchids. Am. Bot. **14**: 1, 2. [My] 1908. [Illust.]

Beddome, R. H. *Gesneraceae*, with annotated list of the genera and species which have been introduced to cultivation. Jour. Roy. Hort. Soc. **33**: 74–100. Ja 1908.

Benedict, R. C. Studies in the *Ophioglossaceae* — I. A descriptive key to *Ophioglossum* in the United States. Torreya **8**: 71–73. 30 Ap 1908.

Berger, A. *Opuntia Miquelii* Monv. Monats. Kakteenk. **18**: 35, 36. 15 Mr 1908.

Berry, E. W. A mid-cretaceous species of *Torreya*. Am. Jour. Sci. IV. **25**: 382–386. *f. 1, 2.* My 1908.

Bicknell, E. P. The ferns and flowering plants of Nantucket — II. Bull. Torrey Club **35**: 181–201. 29 Ap 1908.
Includes *Panicum Owenae* and *Elymus halophilus*, spp. nov.

Bolley, H. L. Observations regarding the constancy of mutants, and questions regarding the origin of disease resistance in plants. Am. Nat. **42**: 171–183. [Ap] 1908.

Brainerd, E. *Viola chinensis* in the Eastern United States. Rhodora **10**: 38–40. [Ap] 1908.

Britton, N. L. North American trees. i–x + 1–894. *f. 1–781.* New York. Ap 1908.

Includes the trees found wild north of the West Indies and Mexico, describing new species in *Populus* (2) *Salix*, *Acer* (2), *Fraxinus* (3), and *Acacia*.

Britton, N. L. The genus *Ernodea* Swartz: a study of species and races. Bull Torrey Club **35**: 203–208. 29 Ap 1908.

Includes *E. Millspaughii*, *E. Nashii*, and *E. Taylori*, spp. nov.

Britton, N. L. Wild Jamaica cotton. Science II. **27**: 665. 24 Ap 1908.

Campbell, D. H. Symbiosis is fern prothallia. Am. Nat. **42**: 154–165. *f. 1–3.* [Ap] 1908.

Clute, W. N. A new fern. Am. Bot. **14**: 8–10. [My] 1908. [Illust.]

Clute, W. N. Compass plant fruits. Am. Bot. **14**: 3, 4. [My] 1908. [Illust.]

Collins, J. F. Some mosses from Aroostook County, Maine. Rhodora **10**: 37, 38. [Ap] 1908.

Cook, M. T. The development of the embryo-sac and embryo of *Potamogeton lucens*. Bull. Torrey Club **35**: 209–218. *pl. 9, 10* + *f. a–f.* 29 Ap 1908.

Cook, O. F. Note on Professor Britton's wild Jamaica cotton. Science II. **27**: 665, 666. 24 Ap 1908.

Cushman, J. A. The New England species of *Closterium*. Bull. Torrey Club **35**: 109–134. *pl. 3–5.* 20 Ap 1908.

Includes *C. Novae-Angliae*, sp. nov. from Massachusetts.

Dowell, P. New ferns described as hybrids in the genus *Dryopteris*. Bull. Torrey Club **35**: 135–140. 20 Ap 1908.

Includes *D. Clintoniana* × *intermedia*, *D. Goldiana* × *intermedia*, *D. Goldiana* × *marginalis*, hybb. nov.

Eaton, A. A. Nomenclatorial changes in *Isoëtes*. Rhodora **10**: 42. [Ap] 1908.

Edgerton, C. W. Two little known Myxosporiums. Ann. Myc. **6**: 48–53. *f. 1, 2.* 31 Mr 1908.

Includes *M. corticolum* and *M. longisporum* spp. nov.

Eichlam, F. *Melocactus guatemalensis* Gürke & Eichlam. Monats. Kakteenk. **18**: 37, 38. 15 Mr 1908.
Described as new.

Evans, A. W. *Hepaticae* of Puerto Rico — IX. *Brachiolejeunea, Ptychocoleus, Archilejeunea, Leucolejeunea* and *Anoplolejeunea.* Bull. Torrey Club **35**: 155–179. *pl.6–8.* 29 Ap 1908.
Includes *Brachiolejeunea insularis* sp. nov.

Evans, A. W. *Lopholejeuna Muelleriana* in Florida. Bryologist **11**: 45, 46. My 1908.

Fobe, F. Einiges über blühende Kakteen. Monats. Kakteenk. **18**: 42–45. 15 Mr 1908.

Foster, A. S. *Polypodium Scouleri.* Muhlenbergia **4**: 21. 14 Ap 1908.

Frič, —. Eine neue Form von *Echinocactus Fričii.* Monats. Kakteenk. **18**: 45. 15 Mr 1908.

Frye, T. C., & Engstrom, E. C. A key to the families of ferns and flowering plants of Washington. 1–19. 1908.

[Gibson, H. H.] American forest trees — 72. Bitternut hickory, *Hicoria minima* Britt. Hardwood Record **25**[12]: 16, 17. 10 Ap 1908. [Illust.]

[Gibson, H. H.] American forest trees — 73. Balsam fir, *Abies balsamea* Linn. Hardwood Record **26**[1]: 16, 17. 25 Ap 1908. [Illust.]

Gifford, J. The names of mahogany. Forestry & Irrig. **14**: 196–198. Ap 1908.

Grout, A. J. Mosses with hand-lens and microscope — IV. 247–318. *pl. 56–75 + f. 134–165.* New York. Ap 1908.

Harper, R. M. Georgia's forest resources. Southern Woodlands **1**[6]: 15–32. F 1908. [Illust.]

Harshberger, J. W. The flora of the Bay of Naples. Old Penn Weekly Review **1908**: 3. 4 Ap 1908.

Hasse, H. E. Lichens collected in the Tehachapi Mountains, California, June, 1907. Bryologist **11**: 55–57. My 1908.

Hay, G. U. Memorial sketch of the late John Moser. Bull. Nat. Hist. Soc. New Brunswick **6**: 46. 1908.

Haynes, C. C. Lucien Marcus Underwood. Bryologist **11**: 41–44. *pl. 4.* My 1908.

Heller, A. A. Two Californian species of *Ribes.* Muhlenbergia **4**: 27–30. 14 Ap 1908.
R. Grantii and *R. purpurascens*, spp. nov.

Houghton, E. M., & Hamilton, H. C. A pharmacological study of *Cannabis americana* (*Cannabis sativa*). Am. Jour. Pharm. **80**: 16–20. Ja 1908.

House, H. D. Studies in the North American Convolvulaceae — IV. The genus *Exogonium*. Bull. Torrey Club **35**: 97–107. *pl. 1, 2.* 20 Ap 1908.

Includes 5 new species from the West Indies and Mexico.

House, H. D. The genus *Rosenbergia*. Muhlenbergia **4**: 22–25. 14 Ap 1908.

Includes *R. Pringlei* sp. nov.

Howe, R. H., & M. A. Common and conspicuous lichens of New England. Part 5. 72–87. Boston. 1908. [Illust.]

Humphrey, H. B. Studies in the physiology and morphology of some California Hepaticae. Proc. Wash. Acad. Sci. **19**: 1–50. *pl. 1, 2.* 18 Ja 1908.

Hus, H. Fasciations of known causation. Am. Nat. **42**: 81–97. [Ap] 1908. [Illust.]

Jackson, H. S. *Sorosporium Ellisii* Winter, a composite species. Bull. Torrey Club **35**: 147–149. 20 Ap 1908.

Includes *S. confusum* sp. nov.

Jeffrey, E. C. On the structure of the leaf in cretaceous pines. Ann. Bot. **22**: 207–220. *pl. 13, 14.* Ap 1908.

Jennings, O. E. A further occurrence of *Wynnea americana* in Pennsylvania. Ann. Carnegie Mus. **4**: 226, 227. *pl. 56.* Ap 1908.

Jennings, O. E. An ecological classification of the vegetation of Cedar Point. Ohio Nat. **8**: 291–340. *f. 1–22.* Ap 1908.

Jordan, D. S. The law of geminate species. Am. Nat. **42**: 73–80. [Ap] 1908.

Knuth, R. Die Gattung *Hypsocharis*. Bot. Jahrb. **41**: 170–174. 24 Mr 1908.

Includes 4 new South American species.

Labroy, O. Les nouveaux maniçobas de Bahia et de Piauhy. Jour. d'Agric. Trop. **8**: 65–71. 31 Mr 1908.

Laumonnier, E. *Ipomopsis elegans*. Rev. Hort. **80**: 108, 109. 1 Mr 1908. [Illust.]

Lemmon, J. G. Notes by a pioneer botanist—I. Muhlenbergia **4**: 17–21. 14 Ap 1908.

Lorenz, A. *Jungermannia* in New Hampshire. Torreya **8**: 55, 56. 27 Mr 1908.

Lorenz, A. Notes on *Jubula pennsylvanica*. Bryologist **11**: 46, 47. *pl. 5*. My 1908.

Maxon, W. R. Studies of tropical American ferns—no. 1. Contr. U. S. Nat. Herb. **10**: i–viii; 473–503. *pl. 55, 56*. 30 Mr 1908.

Includes new species in *Asplenium* (2), *Diplazium*, *Dryopteris* (2), *Elaphoglossum*, *Pellaea*, (2), *Cheilanthes* (2), *Phymatodes*, *Polypodium*, *Stenochlaena*, and *Adiantopsis*, and two new genera, *Holodictyum* (*Asplenieae*), and *Ananthacorus* (*Vittarieae*).

Merrill, G. K. Lichen notes no. 5. Remarks on nomenclature and three new names. Bryologist **11**: 48–53. My 1908.

Mieckley, W. *Opuntia myriacantha* Web. Monats. Kakteenk. **18**: 45, 46. 15 Mr 1908.

Möbius, M. Die Perianthblätter von *Cocos nucifera*. Ber. Deuts. Bot. Gesells. **26a**: 115–124. *pl. 1*. 26 Mr 1908.

Morgan, A. P. North American species of *Agaricaceae*. Jour. Myc. **14**: 64–75. 15 Ap 1908.

Includes *Stropharia drymonia* and *S. micropoda*, spp. nov.

Murrill, W. A. A collection of Philippine polypores. Leaflets Philipp. Bot. **1**: 262–271. 14 Ja 1908.

Murrill, W. A. Collecting and studying *Boleti*. Torreya **8**: 50–55. 27 Mr 1908.

Muschler, R. Die Gattung *Coronopus* (L.) Gaertn. Bot. Jahrb. **41**: 119–147. *f. 1, 2*. 24 Mr 1908.

Nash, G. V. The story of the mangrove. Torreya **8**: 73–78. *f. 1–4*. 30 Ap 1908.

Pammel, L. H. Dr. Edwin James. Ann. Iowa **8**: 161–185; 277–295. 1908 (?).

Pond, R. H. Further studies of solution tension and toxicity in lipolysis. Bot. Gaz. **45**: 232–253. 14 Ap 1908.

Purpus, A. *Yucca valida* Brandegee. Monats. Kakteenk. **18**: 38, 39. 15 Mr 1908. [Illust.]

Quehl, L. *Mamillaria Delaetiana* Quehl, n. sp. Monats. Kakteen. **18**: 59, 60. 15 Ap 1908. [Illust.]

Ramaley, F. Botany of northeastern Larimer County, Colorado. Univ. Col. Stud. **5**: 119–131; i–vi. *f. 1–10*. F 1908.

Ramaley, F., & Robbins, W. W. Ecological notes from north-central Colorado. Univ. Col. Stud. **5**: 111–117. F 1908. [Illust.]

Record, S. J. The forests of Missouri. Southern Woodlands **2**: 10–16. Ap 1908.

Rother, W. Winterbetrachtung über Kakteen. Monats. Kakteenk. **18**: 38, 41, 42. 15 Mr 1908.

Rothrock, J. T. Sweet gum, bilsted (*Liquidambar styraciflua* L.). Forest-Leaves **11**: 120. Ap 1908. [Illust.]

Sears, J. H. A southern flora and fauna of post-pleistocene age in Essex County, Massachusetts. Rhodora **10**: 42–46. [Ap] 1908.

Sluiter, C. P. List of the algae collected by the Fishery-Inspection Curaçao. Rec. Trav. Bot. Néerland. **4**: 231–241. *pl. 8.* 1908.
Includes *Zellera Boekii* sp. nov.

Towle, P. M. Notes on the fruiting season of some of the mosses. Bryologist **11**: 53, 54. My 1908.

Transeau, E. N. The relation of plant societies to evaporation. Bot. Gaz. **45**: 217–231. *f. 1–9.* 14 Ap 1908.

Trelease, W. Variegation in the *Agaveae*. Wiesner Festschr. 332–356. *pl. 6–12.* Wien, 1908.

Wakeman, N. A. Phytochemistry in America. Pharm. Rev. **26**: 151, 152. *portrait.* Ap 1908.
Biographical sketch of Helen Cecilia DeSilver Abbott.

Ware, R. A. *Salix incana* at Castine, Maine. Rhodora **10**: 56. [Ap] 1908.

Warnstorf, C. *Sphagnum Faxonii;* an addition to the flora of New England. Rhodora **10**: 40–42. [Ap] 1908.

Warren, A. E. Selecting a microscope. Am. Bot. **14**: 4–7. [My] 1908.

Wester, P. J. The correlation of flower- and fruit-structure in *Carica Papaya*. Bull. Torrey Club **35**: 141–146. *f. 1, 2.* 20 Ap 1908.

White, C. A. The aggregate origination of parasitic plants. Am. Nat. **42**: 98–108. [Ap] 1908.

Williston, S. W. What is a species? Am. Nat. **42**: 184–194. [Ap] 1908.

1

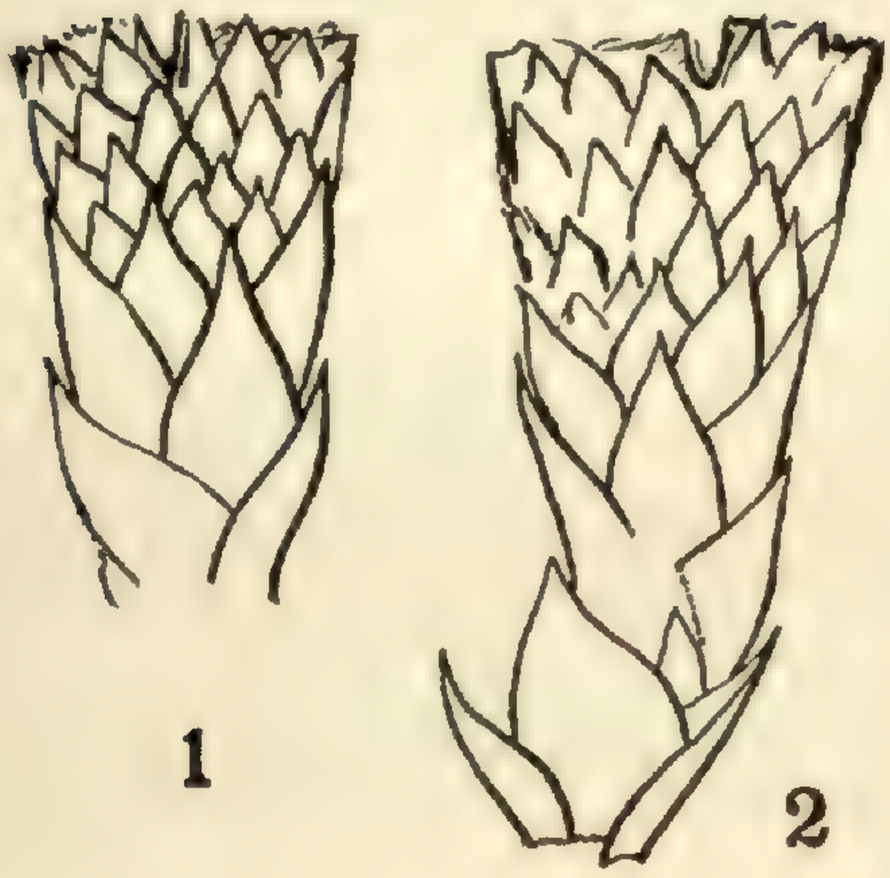
2

3

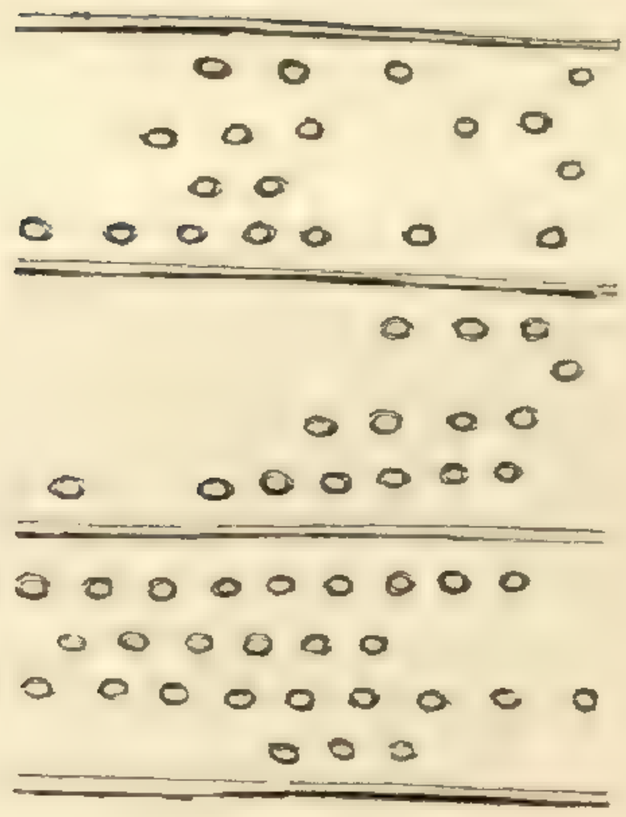
1. MICROZAMIA (?) DUBIA Berry
2. GYMNOSPERMOUS CONE
3. ARAUCARITES ZEILLERI Berry

ARAUCARIA BLADENENSIS Berry

ARAUCARIA BLADENENSIS Berry



1 2



3

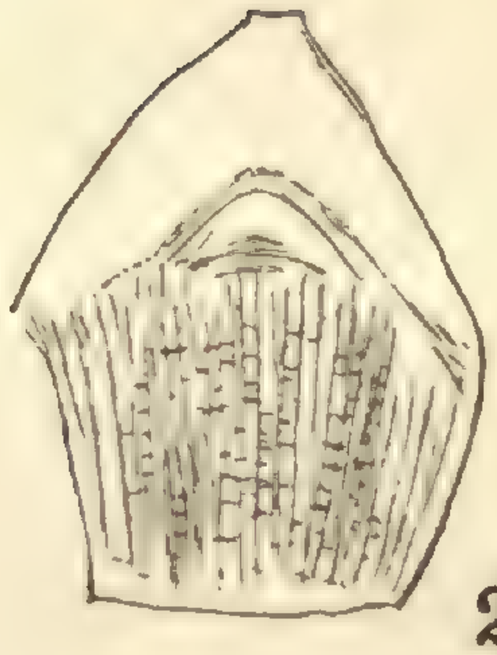
4

5

1–3. ARAUCARIA BLADENENSIS Berry
4 and 5. ARAUCARITES OVATUS Hollick

ARAUCARIA BIDWILLI Hook.

1



2

3

4

5

6

7

8

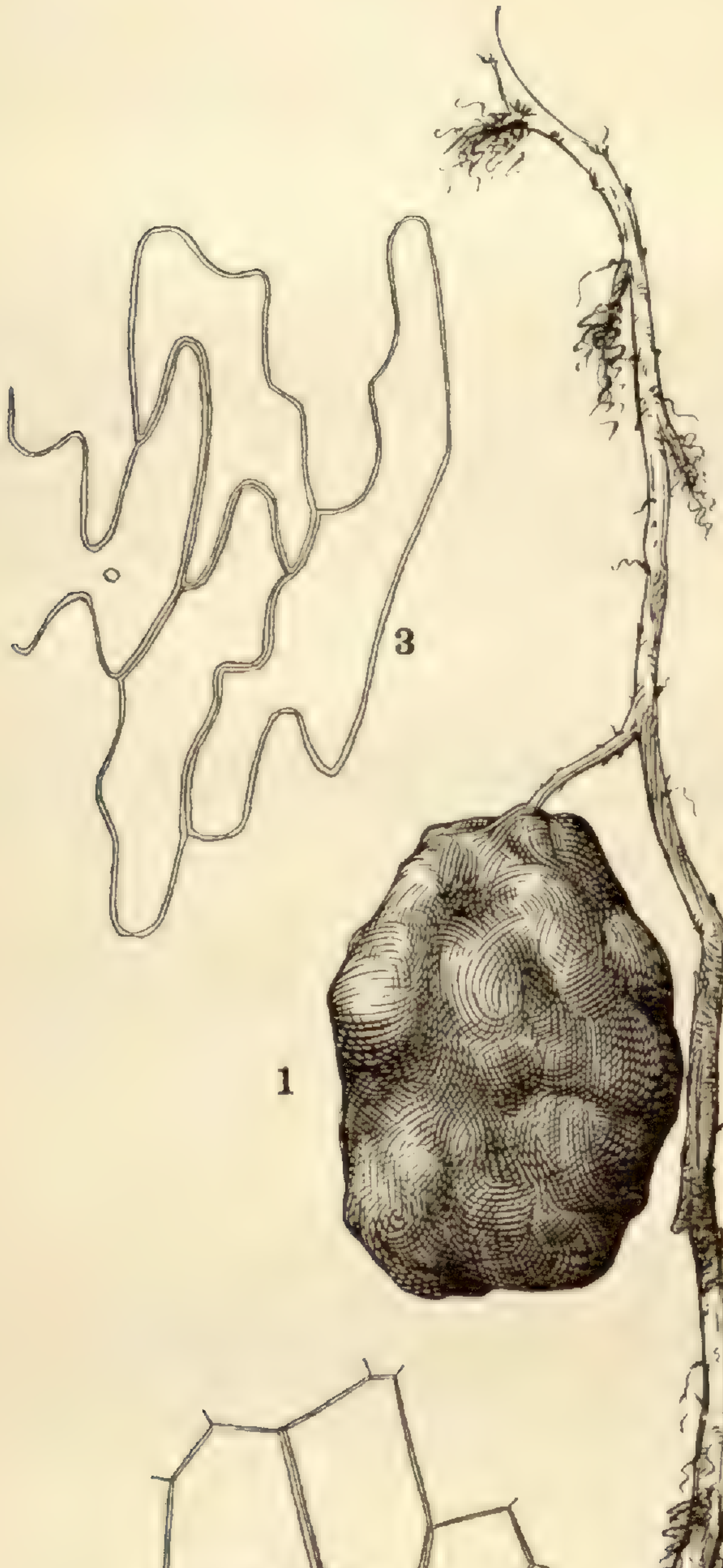
9

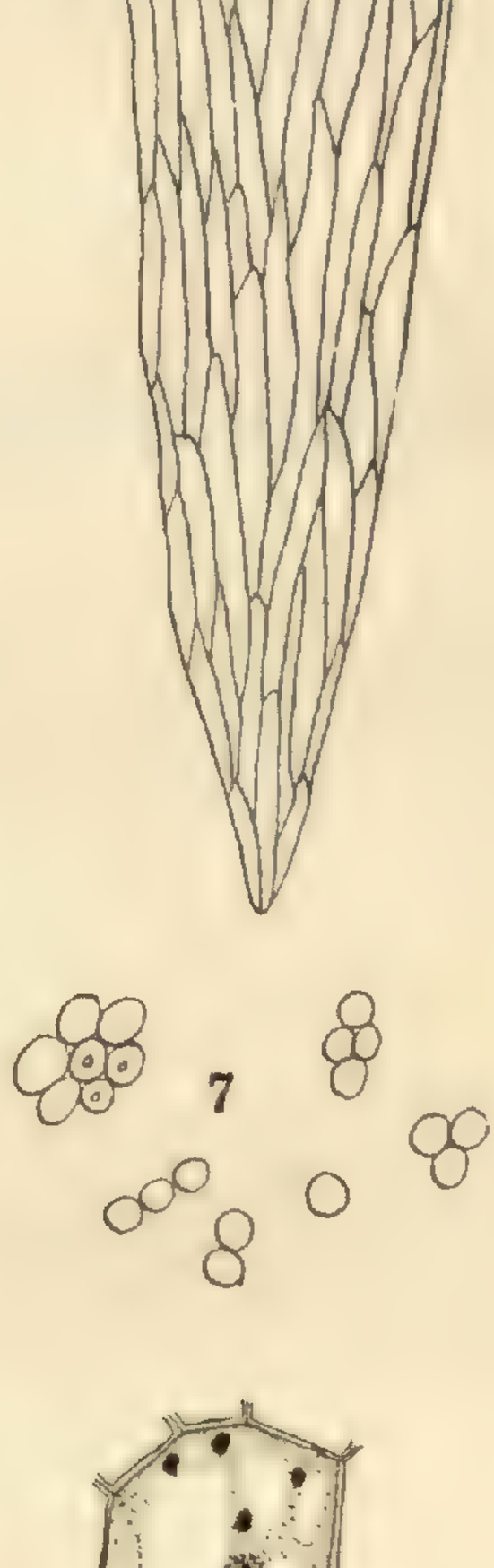
10

11

12

ARAUCARIA JEFFREYI Berry





WATER-STORING TUBERS

FOR SALE

A limited number of sets of Kansas plants (about 1100 numbers each) at $65.00 per set. Address

Department of Botany, Kansas State Agricultural College

MANHATTAN KANSAS

THE BRYOLOGIST

WITH THE JANUARY, 1908, NUMBER BEGINS ITS

ELEVENTH YEAR AND VOLUME

It is a 16–20 page bi-monthly devoted to the study of the Mosses, Hepatics, and Lichens. It is fully illustrated with new, original, and artistic drawings and half-tones. It is indispensable to the working bryologist, professional as well as amateur. Send for sample copy. Subscription price $1.00 a year.

Address, MRS. ANNIE MORRILL SMITH, 78 Orange Street, Brooklyn, N. Y.

INDEX TO AMERICAN BOTANICAL LITERATURE

This Index, printed each month in the BULLETIN, is reissued on library catalogue cards; these are furnished to subscribers at the rate of one cent for each card.

Subscriptions to the card-issue may be addressed to the Treasurer of the Torrey Botanical Club,

WILLIAM MANSFIELD, COLLEGE OF PHARMACY, 115 W. 68th St., N. Y. City.

Beginning with January, 1903, the Index has also been reprinted on paper, on one side only, and can be furnished in that form at the rate of $3.00 a year.

North American Flora

THIS work is designed to present descriptions of all plants growing independent of cultivation, in North America, here taken to include Greenland, Central America, the Republic of Panama, and the West Indies, except Trinidad, Tobago, and Curaçao and other islands off the north coast of Venezuela, whose flora is essentially South American.

It will be published in parts at irregular intervals by the New York Botanical Garden through the aid of the income of the David Lydig Fund bequeathed by Charles P. Daly.

It is planned to issue parts as rapidly as they can be prepared, the extent of the work making it possible to commence publication at any number of points. The completed work will form a series of volumes with the following sequence:

Volume 1. Mycetozoa, Schizophyta, Diatomaceae.
Volumes 2 to 10. Fungi.
Volumes 11 to 13. Algae.
Volumes 14 and 15. Bryophyta.
Volume 16. Pteridophyta and Gymnospermae.
Volumes 17 to 19. Monocotyledones.
Volumes 20 to 30. Dicotyledones.

The preparation of the work has been referred by the Scientific Directors of the Garden to a committee consisting of Professors L. M. Underwood and N. L. Britton.

Professor George F. Atkinson of Cornell University, Professors Charles R. Barnes and John M. Coulter of the University of Chicago, Mr. Frederick V. Coville of the United States Department of Agriculture, Professor Edward L. Greene of the United States National Museum, Professor Byron D. Halsted of Rutgers College and Professor William Trelease of the Missouri Botanical Garden have consented to act as an advisory committee.

The subscription price is fixed at $1.50 for each part; it is expected that four or five parts will be required for each volume. A limited number of separate parts will be sold at $2.00 each. Address,

THE NEW YORK BOTANICAL GARDEN

BRONX PARK, NEW YORK CITY

Vol. 7. Part 1, Ustilaginales, including Ustilaginaceae and Tilletiaceae, by G. P. Clinton, was issued Oct. 4, 1906. Vol. 7, Part 2. Coleosporiaceae, Uredinaceae and Aecidiaceae (pars), of the Uredinales. by J. C. Arthur was issued March 6, 1907. Vol. 22, Part 1, including Podostemonaceae by George V. Nash, Crassulaceae by N. L. Britton and J. N. Rose, and Penthoraceae and Parnassiaceae by P. A. Rydberg, was issued May 22, 1905. Vol. 22, Part 2, including Saxifragaceae and Hydrangeaceae by J. K. Small and P. A. Rydberg, Cunoniaceae, Iteaceae, and Hamamelidaceae by N. L. Britton, Pterostemonaceae by J. K. Small, Altingiaceae by Percy Wilson and Phyllonomaceae by H. H. Rusby, was issued Dec. 18, 1905. Vol. 25, Part 1, including Geraniaceae, by L. T. Hanks and J. K. Small, Oxalidaceae and Linaceae by J. K. Small, and Erythroxylaceae by N. L. Britton. was issued Aug. 24, 1907. Vol. 9, Part 1, Polyporaceae (pars), by W. A. Murrill, was issued Dec. 19, 1907.

PUBLICATIONS BY OFFICERS AND STUDENTS OF THE DEPARTMENT OF BOTANY, COLUMBIA UNIVERSITY

1. MEMOIRS OF THE DEPARTMENT:

Vol. 1. A Monograph of the North American Species of the Genus *Polygonum* (1895). By John Kunkel Small, Fellow in Botany, 1893–1895; Curator of the Herbarium, 1895–1898.

Quarto, 178 pages, 84 plates. Price $6.00.

Vol. 2. A Monograph of the North American Potentilleae (1898). By Per Axel Rydberg, Fellow in Botany, 1896–7.

Quarto, 224 pages, 112 plates. Price $6.00.

2. CONTRIBUTIONS FROM THE DEPARTMENT:

Vol. 1. Nos. 1–25. 1886–1892. Price $5.00.
Vol. 2. Nos. 26–50. 1892–1894. Price $5.00.
Vol. 3. Nos. 51–75. 1894–1895. Price $5.00.
Vol. 4. Nos. 76–100. 1895–1896. Price $5.00.
Vol. 5. Nos. 101–125. 1896–1897. Price $5.00.
Vol. 6. Nos. 126–150. 1897–1898. Price $5.00.
Vol. 7. Nos. 151–175. 1898–1901. Price $5.00.
Vol. 8. Nos. 176–200. 1901–1902. Price $5.00.
Vol. 9. Nos. 201–. 1903–(current).

List of separate numbers available on application.

3. A Text-book of General Lichenology (1896). By Albert Schneider, Fellow in Botany, 1895–1896.

Octavo, 230 pages, 76 plates. Price $4.25 (cloth); $3.80 (paper). Published by Willard N. Clute & Co. Binghamton, N. Y.

The Department invites propositions relative to exchanges of herbarium material for any of the above named publications. Address Dr. Carlton C. Curtis, Columbia University, N. Y. City.

4. An Illustrated Flora of the Northern United States, Canada, and the British Possessions from Newfoundland to the Parallel of the Southern Boundary of Virginia, and from the Atlantic Ocean westward to the 102d Meridian (1896–1898). By Nathaniel Lord Britton, Professor of Botany, 1891–1896; Emeritus Professor 1896–, and Hon. Addison Brown.

Three volumes, royal octavo. Vol. 1, 612 pages; Vol. 2, 642 pages; Vol. 3, 588 pages; 4162 figures in the text, illustrating every species described.

Published by Charles Scribner's Sons, New York. Price, in cloth, $9.00 for the three volumes; with the indexes and keys bound separately, $10.00.

5. Our Native Ferns and their Allies. (Sixth Edition) 1900. By Lucien Marcus Underwood, Professor of Botany, 1896–1907.

Duodecimo, 158 pages, 35 figures. Published by Henry Holt & Co., New York. Price, $1.00.

6. Moulds, Mildews, and Mushrooms. By Lucien Marcus Underwood, Professor of Botany, 1896–1907.

Duodecimo, 236 pages, 10 plates. Published by Henry Holt & Co. Price $1.50.

7. Nature and Development of Plants (1907). By Carlton Clarence Curtis, Assistant in Botany, 1892–1895; Tutor in Botany, 1895–1906; Instructor in Botany, 1906–.

Octavo, 471 pages; 342 illustrations. Published by Henry Holt & Co., New York. Price $2.50.

ESTABLISHED 1851

EIMER & AMEND

205–211 Third Ave.,
Corner 18th Street

NEW YORK

MANUFACTURERS AND IMPORTERS OF

Chemicals and Chemical Apparatus

Our Specialties

MICROSCOPES
and
ACCESSORIES

MICROTOMES

BALANCES
and
WEIGHTS

Sole Agents for

C. A. F.
KAHLBAUM'S
C. P. Chemicals
and Reagents

CARL
SCHLEICHER
& SCHÜLL'S
C. P. Filters

SCHOTT &
GENOSSEN'S
Famous Laboratory Glassware

And for many other renowned European houses in our line.

COMPLETE LINE OF

Bacteriological Apparatus

WE HANDLE

Everything Needed for a Laboratory

Inspection of premises cordially invited.

MEMOIRS OF THE TORREY BOTANICAL CLUB

A series of technical papers on botanical subjects, published at irregular intervals. Price $3.00 a volume. Not offered in exchange.

Vol. 1, No. 1; not furnished separately:

Bailey, Liberty Hyde. Studies of the types of various species of the genus *Carex*. Pages 1–85. 25 My 1889.

Vol. 1, No. 2; not furnished separately:

Martindale, Isaac Comly. Marine algae of the New Jersey coast and adjacent waters of Staten Island. Pages 87–111. 24 Au 1889.

Vol. 1, No. 3; price, 75 cents:

Spruce, Richard. *Hepaticae* Bolivianae, in Andibus Boliviae orientalis, annis 1885–6, a cl. H. H. Rusby lectae. Pages 113–140. 20 Ja 1890.

Vol. 1, No. 4; price, 75 cents:

Sturtevant, Edward Lewis. On seedless fruits. Pages 141–187. 30 My 1890.

Vol. 2, No. 1; not furnished separately:

Halsted, Byron David. Reserve food-materials in buds and surrounding parts. Pages 1–26, *plates 1, 2*. 10 S 1890.

Vol. 2, No. 2; price, 75 cents:

Vail, Anna Murray, & Hollick, Charles Arthur. Contributions to the botany of Virginia. Pages 27–56, *plates 3, 4*. 23 D 1890.

Vol. 2, No. 3; not furnished separately:

Holm, Herman Theodor. Contributions to the knowledge of the germination of some North American plants. Pages 57–108, *plates 5–19*. 15 Ap 1891.

Vol. 2, No. 4; price, 75 cents:

Wheelock, William Efner. The genus *Polygala* in North America. Pages 109–152. 30 D 1891.

Vol. 3, No 1; not furnished separately:

Small, John Kunkel, & Heller, Amos Arthur. Flora of western North Carolina and contiguous territory. Pages 1–39. 20 F 1892.

Vol 3, No. 2; price, $2.00:

Morong, Thomas. The *Naiadaceae* of North America [with illustrations of all the species]. Pages 1–65, *plates 20–74*. 15 Mr 1893.

Vol. 3, No. 3; not furnished separately:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. [Part 1.] Pages 1–67. 28 Ap 1893.

Vol. 4, No. 1; not furnished separately:

Underwood, Lucien Marcus. Index *Hepaticarum*. Part I, Bibliography. Pages 1–91. 10 Je 1893.

Vol. 4, No. 2; not furnished separately:

Small, John Kunkel, & Vail, Anna Murray. Report on the botanical exploration of southwestern Virginia during the season of 1892. Pages 93–201, *plates 75–82*. 18 N 1893–17 Ap 1894.

Vol. 4, No. 3; price, 50 cents:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 2. Pages 203–274. 10 Mr–17 Ap 1895.

Vol. 4, No. 4; price, 50 cents:

Pettit, Anna Stockton. *Arachis hypogaea* L. Pages 275–296, *plates 83–85* 5 Je 1895.

Vol. 4, No. 5; price, 75 cents:

Rydberg, Per Axel. The North American species of *Physalis* and related genera. Pages 297–374. 15 S 1896.

Vol. 5; price, $3.00:

List of *Pteridophyta* and *Spermatophyta* growing without cultivation in northeastern North America. Pages 1–377. 4 D 1893–31 D 1894.

Vol. 6, No. 1; price, $1.25:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 3. Pages 1–130. 17 N 1896.

Vol. 6, No. 2; not furnished separately:

Grout, Abel Joel. A revision of the North American *Isotheciaceae* and *Brachythecia*. Pages 131–210. 30 Jl 1897.

Vol. 6, No. 3; price, 50 cents:

Hazen, Tracy Elliot. The life history of *Sphaerella lacustris* (*Haematococcus pluvialis*). Pages 211–246, *plates 86, 87* (*colored*). 8 Je 1899.

Vol. 6, No. 4; price, 50 cents:

Underwood, Lucien Marcus. A review of the genera of ferns proposed prior to 1832. Pages 247–283. 1 D 1899.

Vol. 6, No. 5; price, 25 cents:

Fink, Bruce. Notes on lichen distribution in the upper Mississippi Valley. Pages 285–307. 1 D 1899.

Vol. 7; price, $3.00:

Howe, Marshall Avery. The *Hepaticae* and *Anthocerotes* of California. Pages 1–208, *plates 88–122*. 5 Au 1899.

Vol. 8, No. 1; not furnished separately:

Lloyd, Francis Ernest. The comparative embryology of the *Rubiaceae*. Part I. Pages 1–26, *plates 1–4*. 26 Au 1899. Part II. Pages 27–112, *plates 5–15*. 15 F 1902.

Vol. 8, No. 2; price, $1.00:

Evans, Alexander William. The *Lejeuneae* of the United States and Canada. Pages 113–183, *plates 16–22*. 15 F 1902.

Vol. 8, No. 3; price, 75 cents:

Britton, Elizabeth Gertrude, & Taylor, Alexandrina. The life history of *Vittaria lineata*. Pages 185–211, *plates 23–31*. 30 Au 1902.

Vol. 9; price, $3.00:

Salmon, Ernest Stanley. A monograph of the *Erysiphaceae*. Pages 1–292, *plates 1–9*. 4 O 1900.

Vol. 10; price, $3.00:

Burgess, Edward Sandford. History of Pre-Clusian botany in its relation to *Aster*. Pages i–xii, 1–447. 22 N 1902.

Vol. 11, No. 1; price, $1.75:

Griffiths, David. The North American *Sordariaceae*. Pages 1–134, *plates 1–19*. 30 My 1901.

Vol. 11, No. 2; price, $1.75:

Hazen, Tracy Elliot. The *Ulothricaceae* and *Chaetophoraceae* of the United States. Pages 135–250, *plates 20–42*. 20 O 1902.

Vol. 12, No. 1; price, $1.50:

Northrop, Alice Rich. Flora of New Providence and Andros (Bahama Islands). Pages 1–98, *plates 1–19 + map*. 10 D 1902.

Vol. 12, No. 2; price, $1.00:

Banker, Howard James. A contribution to a revision of the North American *Hydnaceae*. Pages 99–194. 13 Je 1906.

Vol. 12, No. 3; price, 75 cents:

Kupfer, Elsie. Studies in plant regeneration. Pages 195–241. 10 Je 1907.

Vol. 13; price, $3.00:

Burgess, Edward Sandford. Species and variations of Biotian Asters, with discussion of variability in *Aster*. Pages i–xv, 1–419, *plates 1–13*. 15 Mr 1906.

Vol. 14, No. 1; price, $1.25:

Burlingham, Gertrude Simmons. A study of the *Lactariae* of the United States. Pages 1–109, *figures 1–15*. 26 My 1908.

Address: **TORREY BOTANICAL CLUB,**
Columbia University, New York City.

VOL. 35 JUNE, 1908 NO. 6

BULLETIN

OF THE

TORREY BOTANICAL CLUB

Editor

MARSHALL AVERY HOWE

Associate Editors

JOHN HENDLEY BARNHART
JEAN BROADHURST
PHILIP DOWELL
ALEXANDER WILLIAM EVANS
TRACY ELLIOT HAZEN
WILLIAM ALPHONSO MURRILL
CHARLES LOUIS POLLARD
HERBERT MAULE RICHARDS

CONTENTS

The development of the embryo-sac of Nymphaea advena. (Plates 18 and 19) . . . . . SARA SEATON 283
Notes on Lycoperdon sculptum Harkness. (Plate 20.) WILLIAM ALBERT SETCHELL 291
New North American lichens . . . . . A. ZAHLBRUCKNER 297
Two new grasses from the West Indies . . . . . GEORGE V. NASH 301
The generic name Bucida. . . . . N. L. BRITTON 303
The hypertrophied fruit of Bucida Buceras . . MELVILLE THURSTON COOK 305
Color variation in some of the fungi. . . . . FRED JAY SEAVER 307
INDEX TO AMERICAN BOTANICAL LITERATURE 315

PUBLISHED FOR THE CLUB

THE NEW ERA PRINTING COMPANY
LANCASTER, PA.

THE TORREY BOTANICAL CLUB

President,

HENRY H. RUSBY, M.D.

Vice-Presidents,

EDWARD S. BURGESS, PH.D. JOHN HENDLEY BARNHART, A.M., M.D.

Recording Secretary,

C. STUART GAGER, PH.D.

Botanical Garden, Bronx Park, New York City.

Treasurer,

WILLIAM MANSFIELD, PHAR.D.

College of Pharmacy,
115 West 68th St., New York City.

MEETINGS

Meetings twice each month from October to May inclusive: the second Tuesday, at 8:00 P.M., at the American Museum of Natural History; the last Wednesday, at 3:30 P.M., in the Museum Building of the New York Botanical Garden.

PUBLICATIONS

All subscriptions and other business communications relating to the publications of the Club should be addressed to the Treasurer, William Mansfield, College of Pharmacy, 115 West 68th St., New York City.

Bulletin. Monthly, established 1870. Price, $3.00 a year; single numbers 30 cents. Of former volumes, only 24–34 can be supplied separately; certain numbers of other volumes are available, but the entire stock of some numbers has been reserved for the completion of sets. Manuscripts intended for publication in the BULLETIN should be addressed to Marshall A. Howe, Editor, New York Botanical Garden, Bronx Park, New York City.

Torreya. Monthly, established 1901. Price, $1.00 a year. Manuscripts intended for publication in TORREYA should be addressed to Jean Broadhurst, Editor, Teachers College, Columbia University, New York City.

Memoirs. Occasional, established 1889. (See last pages of cover.)

Preliminary Catalogue of Anthophyta and Pteridophyta within 100 miles of New York City, 1888. Price, $1.00.

Vol. 35 No 6

BULLETIN

OF THE

TORREY BOTANICAL CLUB

JUNE, 1908

The development of the embryo-sac of Nymphaea advena *

SARA SEATON

(WITH PLATES 18 AND 19)

The taxonomic position of the water-lilies or Nymphaeaceae has always been doubtful because of their peculiar and seemingly inconsistent characteristics. The closed vascular bundles, irregularly placed through the stem, are characteristic of monocotyledons, but the reticulate venation of the large peltate leaves is a dicotyledonous character, while the flowers might belong to either class. Moreover, the fruit presents peculiarities that have been interpreted in various ways. Early investigators studied the seed of nearly or quite mature fruit. Recent investigators, using younger material, have, by their studies of development, made clear points not hitherto known. In 1901, H. L. Lyon declared that "the embryo of *Nelumbo* is genuinely monocotyledonous in its development. The plumule arises laterally and at first there is but one cotyledon which later bifurcates to form the two fleshy bodies." The fact that the radicle does not function is another respect in which *Nelumbo* conforms to well-known monocotyledonous types. Because of the characters of the embryo as well as of the mature plant, Lyon concluded that the Nymphaeaceae should be classified among the monocotyledonous families in a subseries coördinate with the Potamogetonineae, Alismineae, and Butomineae, in the series Helobiae.

In 1902, M. T. Cook followed Lyon with his paper on the embryogeny of *Castalia odorata* and *Nymphaea advena*, in which he confirmed the views already given. In 1904 Schaffner, in his

* Contribution from the Department of Botany of Cornell University, No. 128.

[The BULLETIN for May, 1908 (35: 223–282. *pl. 11–17*) was issued 29 My 1908.]

paper on morphological peculiarities of Nymphaeaceae and Helobiae, agreed with Lyon and Cook as to the monocotyledonous embryo and vascular bundles, and went farther in saying that he found even the flower could be made to fit into the monocotyledonous scheme. The six sepals of *Nymphaea advena* could be considered a perianth typically trimerous with three sepals and three petals. Even in *Castalia odorata*, said to have four sepals, the sepals are normally three in a cycle, but sometimes there is an expansion of the receptacle causing one sepal of the second cycle to be brought outside. Schaffner maintains that many superficial characteristics of secondary importance, such as similarity to Helobiae in habitat, rhizome habit, leaf forms, and number and arrangement of ovules in ovularies, add strength to the monocotyledonous idea. The embryo of *Castalia odorata* which Conard finds "to have two cotyledons from the first," Schaffner, by dissecting out very young embryos, found to show a resemblance to *Nelumbo* and *Nymphaea* that could much less easily be seen in serial sections. Schaffner concludes his paper with the prediction that with our increasing knowledge of the embryogeny of angiosperms we shall be inclined to divide them into a number of parallel groups rather than maintain the two of our present classification, dicotyledons and monocotyledons. Perhaps a similar idea is expressed in another form by Mottier who calls the Nymphaeaceae anomalous dicotyledons.

Since Cook's paper on embryogeny was based upon the first stages of the development from *Castalia odorata* material, and the later stages from *Nymphaea advena*, I give my own study of the development of the embryo-sac, based altogether on abundant material of *Nymphaea advena* in all the stages.

THE EMBRYO-SAC OF NYMPHAEA ADVENA

The material was collected at Ithaca, N. Y., and Cleveland, Ohio. Twice in July, and again twice in August, for three consecutive summers, buds and flowers of various ages were collected in the bayous of Fall Creek and in the Inlet of Cayuga Lake at Ithaca. In September, at the same place, several plants were uprooted and from the crown small young buds, formed for the next season, were obtained. As these proved to be too young to

show the floral parts, no further material was gathered in the autumn, but collections were made for two consecutive seasons in May, from a small lake thirty miles east of Cleveland. From every collection made, buds and open flowers of varying size and general appearance were selected. Although floating buds of any given collection showed a wide range of gross development, very little variation in the condition of the embryo-sac was found in such material; that is, size and general external appearance are no definite guide to internal development in this species. The season, rather than the gross appearance, is the best criterion of the conditions of development.

Material collected in July and August was carried to the laboratory for killing and fixing; that gathered in May was put in the fixing fluid at the place of collection. At first, the outer floral parts were removed and the pistil cut vertically into from eight to twelve radial pieces, but later all except the youngest ovules were removed from the pistil and fixed separately. In removing the ovules, the large quantity of gelatinous substance made the work difficult. Flemming's chromo-aceto-osmic mixture and chromo-acetic acid were used. Because of the gelatinous substance surrounding the ovules, Wager's alcoholic fixer was tried, but the aqueous fixers gave much better results. The separate ovules, when of small size, were slightly stained *in toto*, with picro-carmine after fixing, in order that they might be more easily seen during subsequent treatment in grades of alcohol, cedar oil, and in paraffin. Sections of varying thickness were cut and stained with different stains, Flemming's triple stain giving the best results. A large number of slides was prepared and all the points figured were observed in many preparations.

This investigation was carried on in the botanical laboratory of Cornell University, under the direction of Professor Atkinson and with the assistance, at first, of Dr. Margaret C. Ferguson and later of Dr. E. J. Durand.

In May, before the integuments begin to develop, a single hypodermal archesporial cell can be distinguished (*figure 1*). This hypodermal cell divides by a transverse wall into an upper cell, the primary parietal cell, and a lower one, the megaspore mother-cell (*figures 2, 3*). The primary parietal cell divides irreg-

ularly, so that the megaspore mother-cell is soon seen to be buried four cells deep (*figure 6*). It expands somewhat and is marked by an abundance of cytoplasm (*figure 5*). At the time of the division of the hypodermal cell, the beginning integuments can be seen, in section, as rounded protuberances from the base of the ovule (*figure 2*). The megaspore mother-cell soon divides transversely into two cells. The succeeding divisions are somewhat irregular. Usually the micropylar daughter-cell next undergoes division (*figure 7*) and after that the chalazal cell, but sometimes the chalazal cell divides first. At other times after the micropylar cell has divided so that a row of three cells has been formed, the middle cell next divides instead of the lower one. Whatever be the succession of divisions, they result in the normal production of an axial row of four cells, or "megaspores," of which the lower one is functional. I have an abundance of material showing the above steps. By irregular divisions of the parietal tissue and of the epidermal tissue at the tip of the ovule simultaneously with the formation of the four megaspores, the functional "megaspore" or embryo-sac mother-cell is buried to the depth of from six to ten cells below the micropylar end of the ovule. The functionless megaspores then degenerate (*figure 9*) so that the embryo-sac mother-cell lengthens toward the micropyle (*figure 10*).

The embryo-sac mother-cell enlarges in the direction of the longitudinal axis of the ovule in the two-nucleate stage (*figure 11*), and broadens in the four-nucleate stage (*figure 12*). The mature embryo-sac further expands toward the micropyle until it is within eight, six, or even four cells of the micropylar end of the ovule (*figures 17, 18*), but never extends to the superficial row of cells as Cook found in *Castalia odorata*. The nucellar tissue between the upper end of the embryo-sac and the micropyle at this time assumes a characteristic appearance; the cells seem crowded, as they are smaller and more compact than at any previous time. They are also arranged in very regular rows. The cytoplasm is so abundant as to leave no vacuoles in these cells and they appear to be stored with food (*figure 17*). At the time the embryo-sac has reached the eight-nucleate stage it occupies one half the length of the ovule (*figure 13*). The polar nuclei fuse and the antipodals soon disappear. The fusion-nucleus is very large (*figures 15, 17*).

Dense cytoplasm surrounds the egg-apparatus, but it is scanty in the rest of the sac, thin streamers extending from the egg-apparatus to the large endosperm-nucleus and from that to the antipodal end of the sac, often following the general direction of the sides but not touching them.

The early embryo-sac appears elliptical in section. The shape of this part of the sac does not change, but in the eight-nucleate stage, at the antipodal end, there is formed a tube-like elongation, which in time reaches to the chalazal end of the ovule. This basal prolongation is always narrower than the older part at the micropylar end of the sac and seldom has a liberal supply of cytoplasm (*figure 13*). At the juncture of the tube-like lower part with broad elliptical upper part of the embryo-sac is a constriction. It is in this constricted part that the large fusion-nucleus or endosperm-nucleus lies. Although the sac lies straight in the axis of the ovule, occasionally, in sectioning, cells from the surrounding tissue appear to be in the sac. These fragments may have given rise to the idea that a cross-wall appears in the sac at this point at the time of the division of the large endosperm-nucleus, which, as stated, always lies in this constricted part (*figures 13, 16*). In my material, this endosperm has been observed soon after division, but a cross-wall in the embryo-sac between the two nuclei, such as described by Cook for *Castalia odorata*, has not been seen. The endosperm-nucleus lying in the constricted part of the sac then divides into two. The upper endosperm-nucleus later divides to form the endosperm tissue while the lower (antipodal) endosperm-nucleus moves down into the chalazal end of the tube-like portion of the sac, enlarges, and often persists until the embryo is quite advanced (*figure 21*). Soon after fertilization of the egg-nucleus the perisperm shows an accumulation of starch. This food supply is remarkably abundant in all the older ovules studied (*figure 20*).

After fertilization the cytoplasm of the sac always gathers about the fertilized egg in a spherical mass. It is vacuolate, with thread-like dense portions radiating from the nucleus to the surface of the sphere of cytoplasm. The cytoplasm from the pollen-tube is dense and takes the stain deeply (*figure 14*). One synergid persists and is very similar to the fertilized egg in appearance

except that it lacks the surrounding regular-shaped mass of cytoplasm. The endosperm-nucleus in the constriction of the sac sometimes divides at this time but usually later. The lower endosperm-nucleus in the chalazal end of the long tube-like portion of the sac is very large and conspicuous with a reticulated surface and a large dense nucleolus (*figures 14, 19*).

The young embryo is nearly spherical, lying against the wall at the micropylar end of the sac, and is nearly surrounded by endosperm. This endosperm tissue is surrounded by perisperm containing a rich food supply. The endosperm tissue never extends into the tube-like base of the embryo-sac but the nucellus closing in from the sides obliterates it, often leaving only the cavity at the extreme chalazal end containing its persisting nucleus (*figures 20, 21*).

SUMMARY

1. The hypodermal cell can be distinguished before the integuments begin to develop.

2. The integuments begin to develop at the time of the division of the hypodermal cell.

3. By the division of the parietal cell the megaspore mother-cell is buried four cells deep.

4. The order in which the four cells of the axial row arise varies, but the lowest one always functions.

5. By simultaneous division of the epidermal and the parietal tissue the embryo-sac is buried six to ten cells below the micropylar end of the ovule.

6. The functionless megaspores degenerate so that the embryo-sac mother-cell lengthens toward the micropyle.

7. The embryo-sac expands until within eight, six, or even four cells of the micropylar end of the ovule, but never to the superficial row of cells as Cook found to be the case in *Castalia odorata*.

8. The nucellar tissue between the upper end of the sac and the micropyle assumes a characteristic appearance; cells crowded, small, dense, in regular rows and stored with food.

9. The eight-nucleate embryo-sac develops a tube-like prolongation toward the chalazal end of the ovule. This tube is always narrower where it joins the broadly elliptical upper part of the sac than throughout the rest of its extent.

10. The large fusion-nucleus lies in the narrow part of the tube-like prolongation of the embryo-sac.

11. When this fusion-nucleus divides, it does not form a wall across the embryo-sac as Cook found in his material.

12. The scanty cytoplasm of the embryo-sac gathers around the fertilized egg in a characteristic manner.

13. The fusion-nucleus may divide at the time of fertilization of the egg but usually this occurs later.

14. The lower endosperm-nucleus, arising from the division of the fusion-nucleus, travels to the chalazal end of the tube-like part of the sac and persists until the embryo has attained considerable size.

15. The embryo is spherical, lying against the wall, almost surrounded by endosperm, within the perisperm, rich in food.

16. The Nymphaeaceae are monocotyledonous in embryology, vascular tissue, habit, and possibly even in floral arrangement.

LITERATURE

Conard, H. S. The water lilies: a monograph of the genus *Nymphaea*. The Carnegie Institution of Washington, Publication no. 4. 1905.

Cook, M. T. Development of the embryo-sac and embryos of *Castalia odorata* and *Nymphaea advena*. Bull. Torrey Club **29**: 211–220. *pl. 12, 13*. 1902.

Lyon, H. L. Observations on the embryogeny of *Nelumbo*. Minn. Bot. Stud. **2**: 643–655. *pl. 48–50*. 1901.

Schaffner, J. H. Some morphological peculiarities of the Nymphaeaceae and Helobiae. Ohio Nat. **4**: 83–92. *pl. 5–7*. 1904.

CORNELL UNIVERSITY,
ITHACA, NEW YORK.

Explanation of plates 18 and 19

All figures were drawn with the aid of an Abbé camera lucida.

FIG. 1. Nucellus with archesporial cell.

FIG. 2. Archesporial cell dividing.

FIG. 3. The primary parietal cell and the megaspore mother-cell.

FIG. 4. Two parietal cells and the megaspore mother-cell.

FIG. 5. The enlarged megaspore mother-cell.

FIG. 6. The megaspore mother-cell buried four cells deep by the increase of parietal tissue.

FIGS. 7 and 8. The dividing micropylar cell in the axial row of megaspore-cells.

FIG. 9. The functional megaspore, with the degenerating functionless megaspores.

FIG. 10. The division of the embryo-sac mother-cell.

FIG. 11. The two-nucleate stage of the embryo-sac.

FIG. 12. The simultaneous division of the two nuclei to form the four-nucleate sac.

FIG. 13. An ovule with a mature embryo-sac, after fusion of polars and disappearance of antipodals; showing the position in ovule and relative size of the sac.

FIG. 14. Entire embryo-sac, showing characteristic appearance and arrangement of sac-nuclei just after fertilization.

FIG. 15. Mature embryo-sac, showing egg-apparatus and endosperm-nucleus.

FIG. 16. An ovule, showing embryo-sac ready for fertilization.

FIG. 17. Upper end of a sac, showing condensed cells between sac and the micropyle.

FIG. 18. The upper part of sac no. 14, showing details.

FIG. 19. The lower part of sac no. 14, showing details.

FIG. 20. The embryo with endosperm tissue and perisperm tissue containing starch.

FIG. 21. The chalazal end of ovule in 20, showing the persisting lower endosperm-nucleus.

Notes on Lycoperdon sculptum Harkness

WILLIAM ALBERT SETCHELL

(WITH PLATE 20)

The large puffball of the Sierra Nevada Mountains of California was first made known in 1885 by Dr. H. W. Harkness, in the first volume of the Bulletin of the California Academy of Sciences (page 160), with the general statement that it is "found only at considerable elevations, 6,000 to 8,000 feet in the Sierra Nevadas." In conversation several years since, Dr. Harkness told me that the original specimens came from some locality on the eastern slopes, but he seemed uncertain as to the exact locality. At that time, the "Harkness Collection of Fungi," which had been given to the Academy, was not in order and I was unable to make any search. The type, however, was preserved as a museum specimen under glass with no data accompanying it. After the death of Harkness, the collection was placed in order by Miss Alice Eastwood, curator of the herbarium and I made an examination of all the specimens of this species contained in it with notes as to my results. I found only one specimen with the locality marked and that came from near Summit in Placer County, at an altitude of about 6,700 feet. This is probably, then, to be considered as the type locality.

In the herbarium of the University of California, there are several good specimens of this species and with satisfactory data. One came from Summit, our supposed type locality, where it was collected by Mrs. Charles H. Shinn. One of the earliest specimens to be received at the University was collected by Mr. D. T. Fowler, in Sierra Valley, in Sierra County, at an altitude estimated by him to be about 4,800 feet. He also reports finding several specimens along the road between Sierra Valley and Truckee. These collections were reported by J. Burtt Davy in the "Reports of the work of the Agricultural Experiment Station of the University of California for the years 1898–1901" (page 353), under the name of *L. insculptum* (error in copying). Several specimens in perfectly ripe condition were collected by C. C. Dobié and myself

in the neighborhood of Emerald Bay, Lake Tahoe, at about 6,500 feet in 1901. They were so mature that they fell to pieces during transportation to Berkeley. There is a specimen, somewhat immature, collected by H. N. Bagley in June, 1902, at Tamarack Flat, on the Big Oak Flat Road in Mariposa County, at an altitude of 6,400 feet. Finally there have recently been added to the herbarium specimens collected by Dr. H. M. Hall, at Bluff Lake in the San Bernardino Mountains in July, 1908, at an altitude of 8,300 feet. Besides these specimens in the herbarium of the University of California, there are a few in other collections known to me. Lloyd mentions in his Mycological Notes (No. 18, page 203, 1904) that he had received a specimen from Professor W. C. Blasdale collected near Lake Tahoe and that there is in the herbarium at Kew, some ripe gleba sent by Harkness. The specimens of Harkness were destroyed in the fire of April, 1906, which destroyed as well the buildings and most of the collections of the California Academy of Sciences. I learn from Mr. S. B. Parish of San Bernardino, that he also collected a specimen at Bluff Lake, the same locality whence Dr. Hall procured his specimens, and sent it to the late A. P. Morgan, in whose collection I presume that it may still be found. These are all the collections known to me.

In 1906, I published in the Sierra Club Bulletin (6: 39) a popular description of this puffball under the title of "The Sierran Puffball" and illustrated it with photographs. It was really an appeal to members of the Sierra Club to note the occurrence and report localities and altitudes at which they might find it. As a response, several members of the Club have told me of specimens seen and with sufficiently definite information as to appearance to make it reasonably certain that it was this and no other species observed. This information, with an item received before the publication of the article, I append as hearsay, but none the less, credible evidence as to range in latitude and altitude. The late Professor J. J. B. Argenti, of San Francisco, evidently found it at Crane Flat, on the Big Oak Flat Road, at an altitude of 6,300 feet. Professor C. B. Bradley, of Berkeley, reports it from the head of Bear Valley, in Alpine County, at an altitude of 6,500 feet. He found it in 1895. Mr. H. O. Wood, of Berkeley,

reports it from above Lake Tenaya, in Mariposa County, at an altitude of between 8,200 and 8,300 feet. Mr. William E. Colby, of San Francisco, Secretary of the Sierra Club, found it in the Tuolumne Meadows, at about 8,500 feet and, tasting the raw flesh, found it to be very agreeable in flavor. Mrs. Katherine Brandegee, of Berkeley, saw some specimens collected by others in the Giant Forest of the Sequoia National Park, at an altitude of about 6,500 feet.

From the evidence given above, it seems well ascertained that the distribution of *Lycoperdon sculptum* extends at least from Sierra Valley on the north, down along the Sierra Nevada and San Bernardino Mountains to Bluff Lake and that in altitude, it ranges from 4,800 feet up to 8,500 feet. The striking range as regards altitude, as well as the extraordinary markings of this species may well make one wonder as to whether it is likely to be retained in *Lycoperdon* or one of its segregates, or made the type of a distinct genus. While I do not intend to attempt to settle this question, it seems desirable to add some description of the species drawn from both the living and the dried specimens.

So far as I may learn, *Lycoperdon sculptum* is most usually found in alluvial soil and often among the willows which border small streams, but it is also found in the drier soil under pines and perhaps also under *Sequoia gigantea*. As I found it myself, there were nearly a dozen specimens in the same small area, but often single specimens are found with no others near them. They are fairly conspicuous objects up to the time that the peridium falls away and exposes the spores. The peridium retains its light color until maturity.

The shape of a well-developed specimen is that of a pear, somewhat, or even considerably, flattened laterally. The size varies from about 10 to 20 cm. in the longest horizontal diameter and the plants reach a height of 10 to 15 cm. The sterile base of the puffball is stout, usually buried in the ground, and it has the remnants of stout mycelial strands at its very base. This is well represented in the upper and left middle specimens in the photograph reproduced in connection with this paper. The upper portion of the puffball is sometimes nearly globular, but is generally very decidedly flattened laterally and has the outer peridium

broken up into coarse pyramidal areas which surpass in size, especially in height, those of any known puffball, unless it may be such species as those of *Phellorina* or *Scleroderma strobilinum.* These pyramidal projections in *Lycoperdon sculptum* are well represented in the right middle specimen in the accompanying plate, which, however, is reduced to one half the proper diameter. They are often as much as 3.5 cm. in basal diameter and reach a height of 3 cm.; they taper to a more or less sharp apex, which is generally incurved, and are marked with horizontal lines, representing the layers of the thick outer peridium. They are reasonably well shown in the original figure of Harkness (*loc. cit.*) but do not show very well in the figure given by Lloyd (*loc. cit.* 203. *f. 81*). They remain persistent until the final breaking up of the whole peridium, not in any way appearing to be evanescent or caducous.

Many specimens of *Lycoperdon sculptum* are affected by the attacks of insects or by dry conditions, or some other influence, so that they do not develop beyond a certain stage, such as is represented in the two lowermost figures in the photograph which accompanies this paper. They become somewhat mummified and in this condition are easily transported and preserved. They show fairly well the main external characters of the projections, but do not reach the normal size or attain the normal shape. The specimen figured by Lloyd (*loc. cit.*) seems to be one of this sort. Such specimens well represent stages in development, but not the typical adult plant.

The gleba, in well-developed specimens, is white at first, later turning yellowish, then an intense yellow and finally a decided umber, as the spores ripen. It is early readily separable from the peridium and from the tissues of the stipe. The spores are rough and about 2–3.5 μ in diameter, light yellowish and nearly smooth when young, becoming dark and slightly but evenly warted when mature. Harkness, and all who follow him, say that the spores are smooth, and young spores, which, judging from the descriptions of the color of the gleba ("yellow") are all that they have had to examine, appear smooth, but, in the really mature glebae which I have, the spores are plainly rough even with ordinary high powers, while with the one-twelfth inch oil-immersion, the regular warted character is plainly to be seen. The size of the spores is the same

in all the mature specimens that I have been able to examine and differs from that as given by Harkness, viz., "5–8 μ," in that the average runs from 2 μ to 3.5 μ. Occasionally a larger spore is seen, but I have not been able to obtain any measurements approaching those of Harkness. The capillitium threads, in the really matured specimens, are thick-walled and of the same color as the spores. They are short and very seldom show any branching at all. For the most part, the ends appear broken, but in some cases they are rounded.

I have chosen to use the name for this species which was given to it by Harkness. There seems to be no definite agreement as yet as to just how and upon what characters the genus *Lycoperdon* shall be segregated. In the matter of dehiscence, however, it does not belong to that section of the genus whose members open by means of an apical pore, but rather to that section in which the peridium breaks up into plates which, falling off, gradually expose the whole ripened gleba. This brings the species into the genus *Calvatia* in the sense in which it is used by some authors. It is also "stipitate," and this may be another reason for considering it to belong to this genus, should it be decided to keep it distinct. It has already been referred to *Calvatia* by Lloyd (*loc. cit.*, under "*Calvatia sculptum*"). As to its relation to the genus *Arcolaria*, or as to its being the type of a new genus, I have very little to say, except that I agree with Lloyd that its nearest relative seems to be *Lycoperdon caelatum* Bull., which is also referred to *Calvatia*.

UNIVERSITY OF CALIFORNIA,
BERKELEY, CALIFORNIA.

Explanation of plate 20

The uppermost figure represents a mature specimen which has lost most of the peridium and gleba, while the left middle figure represents one which has lost all of the upper portion and is reduced to the sterile "stipe." The two lowermost figures show mummified young specimens. All the four specimens just mentioned were collected by C. C. Dobie and myself near Emerald Bay, Lake Tahoe, California, and are preserved in the herbarium of the University of California.

The right middle figure represents a portion of the peridium of a mature specimen, seen from above. It was collected in Sierra Valley, California, by D. T. Fowler, and is in the herbarium of the University of California.

All the figures were photographed and are reproduced at one half the diameter of the original specimens.

New North American lichens

A. Zahlbruckner

During the months of February and March, 1908, Mr. J. C. Blumer collected lichens in the vicinity of the Desert Botanical Laboratory near Tucson, Arizona, and sent them to Professor Bruce Fink to work over for an ecologic paper to be finished the following May. The time for critical study being short and Professor Fink being busy with the ecologic study, the writer was called upon to aid him in the determination of some of the more difficult species. The new species and the one variety described below result from my work upon the collection. The type specimens are deposited in the herbarium of the K. K. Naturhistorisches Hofmuseum at Vienna; type duplicates are in the possession of Professor Bruce Fink of Miami University, Oxford, Ohio.

Acarospora Carnegiei A. Zahlbr. sp. nov.

Thallus rufescenti-cervinus vel rufescenti-fuscus opacus, KHO–, $CaCl_2O_2$ leviter erythrinosus, hyphis medullaribus partis centralis squamorum substrato affixus, squamulosus, squamis plus minus congestis, angulosis vel anguloso-rotundatis, 0.3–1 mm. latis, 0.3–0.35 mm. crassis, modice convexis vel subplanis, subtus obscuratis, utrinque corticatus, cortice 30–40 μ alto, pseudoparenchymatico, cellulis angulosis, leptodermaticis, minutis; gonidiis infra corticem stratum latum continuum formantibus, palmellaceis, globosis, 9–13 μ latis, laete viridibus; hyphis medullaribus intricatis, non amylaceis. Apothecia in squamulis primum 1–3, evoluta tamen solitaria, immersa, 0.4–0.7 mm. lata, rotunda; disco concaviusculo vel plano, demum dilatato, dense caesio-pruinoso; margine proprio nigro, angusto, parum prominulo, integro vel subintegro; perithecio dimidiato, fuligineo, parum incrassato; epithecio pulverulento, crassiusculo, fuscescente, KHO olivaceo-lutescente, $CaCl_2O_2$–; hymenio decolore, usque 200 μ alto, I leviter caeruleo, dein rufescente et demum obscurato; paraphysibus crebris, filiformibus, conglutinatis, strictis, eseptatis, guttulis oleosis minutis et numerosis impletis, ad apices haud latioribus; ascis hymenio parum brevioribus, oblongo- vel ellipsoideo-clavatis, apice rotundatis et membrana incrassata cinctis, myriosporis; sporis decoloribus, simplicibus, ovalibus, ovali-oblongis vel oblongis, membrana tenuissima cinctis, 5–5.5 μ longis et ad 2 μ latis.

Species apotheciorum disco pruinoso et perithecio fuligineo dimidiatoque distincta.

On loose blocks of tuff or basalt.

Caloplaca amabilis A. Zahlbr. sp. nov.

Sect. *Eucaloplaca.* Thallus epilithicus, squamulosus, squamulis plus minus congestis, substrato haud arcte adpressis, rotundatis, subangulosis vel irregularibus, minutis, 0.3–0.8 mm. latis, convexiusculis, glaucis vel glauco-aeruginascentibus, nitidulis, ad marginem nonnihil paulum adscendentibus et tum anguste albomarginatis, superne corticatus, cortice pseudoparenchymatico, cellulis minutis, sat pachydermaticis, luminibus rotundatis, decolore, in parte suprema cinerascente et KHO violaceo; gonidiis palmellaceis, cellulis 10–15 μ latis, infra corticem stratum sat crassum et continuum formantibus; medulla albescente, ex hyphis intricatis, non amylaceis formata. Apothecia erumpentia, demum sessilia, minuta, 0.25–0.3 mm. lata; disco primum dilute luteo, demum fulvo vel fulvo-aurantiaco, ceraceo, convexo, nitidulo, epruinoso; margine tenui, subintegro, mox depresso; excipulo tenui, ex hyphis tenuibus radiantibusque formato, gonidia haud includente; epithecio angusto, fulvo-aurantiaco, pulverulento, KHO purpureo; hymenio decolore, I violaceo-coeruleo; hypothecio decolore, ex hyphis intricatis formato, strato gonidiifero superposito; paraphysibus densis, simplicibus, tenuiter septatis, apicem versus constricto-septatis; ascis hymenio subaequilongis vel parum brevioribus, oblongis, ad apices cuspidato-rotundatis et ibidem membrana incrassata cinctis, 8-sporis; sporis in ascis biserialibus, obliquis, decoloribus, ellipsoideis, oblongo-ellipsoideis vel ovalibus, apicibus rotundatis, polari-diblastis, isthmo distincto, 9–13 μ longis et 5.5–7 μ latis.

On basaltic rocks and boulders.

Caloplaca elegans brachyloba A. Zahlbr. var. nov.

Sect. *Gasparrinia.* A typo distat lobis brevibus, ad 1 mm. longis, digitato-incisis.

On loose blocks of tuff and basalt.

Xanthoria modesta A. Zahlbr. sp. nov.

Thallus tenuissimus, effusus, siccus glauco-cinerascens, opacus, madefactus laete viridis, foliaceus, lobis minutis, ad 0.5 mm. latis vel minoribus, substrato plus minus adpressis vel ad margines leviter ascendentibus, congestis, inciso- vel digitato-lobatis, lobis valde brevibus, ad margines hinc inde granulatis, granulis thallo concoloribus, rhizinis nullis, utrinque pseudoparenchymaticus, cellulis leptodermaticis mediocribus, superne anguste infuscatus et KHO (sub lente visus) purpurascens; gonidiis palmellaceis, majusculis, 9–12 μ latis, laete viridibus, in thallo crebris. Apothecia minuta, ad 0.2 mm. lata, rotunda, dispersa vel raribus approximata, sessilia; disco e plano demum modice convexo, aurantiaco, epruinoso, KHO purpureo; margine thallino tenuissimo, thallo

concolore, integro, primum haud prominulo, demum depresso; excipulo pseudoparenchymatico, cellulis leptodermaticis, angulosis, gonidia continente; epithecio anguloso, pulverulento, KHO purpureo; hypothecio decolore, sat lato, pseudoparenchymatico; hymenio decolore, in parte suprema aurantiaco-ochraceo, 100–110 μ alto, I violaceo-coeruleo; paraphysibus filiformibus, crebris, concretis, ad apices paulum latioribus et constricto-septatis; ascis hymenio subaequilongis vel parum brevioribus, ellipsoideis vel oblongis, ad apices parum angustatis et rotundato-retusis, membrana ibidem bene incrassata, 8-sporis; sporis in ascis 2–3-serialibus, decoloribus, polari-diblastis, isthmo tenuissimo, late vel angustius ellipsoideis, 9–12 μ longis et 7–8 μ latis.

Xanthoria ob anatomiam thalli; species peculiaris.

On basaltic rocks.

Leptogium arizonicum A. Zahlbr. sp. nov.

Sect. *Euleptogium*. Thallus olivaceo-obscuratus, modice gelatinosus, imbricato-lobatus, lobis rotundatis vel inciso-rotundatis, ascendentibus, concavis, tenuibus, sorediis et isidiis destitutis, utrinque corticatus, cortice e serie unica cellularum formato magnarum et leptodermaticarum, parte centrali thalli gonidia nostocacea numerosa et approximata continente. Apothecia superficialia, sessilia, basi angustata, usque 1 mm. lata, primum bene concava, fere gyalectoidea, demum subplana vel modice convexa; disco obscurato, epruinoso, nitidulo; margine proprio tenui, integro, parum prominulo, extus grosse pseudoparenchymatico, cellulis in seriebus 3–4 angulosis, intus parum gelatinoso; perithecio angusto, decolore, pseudoparenchymatico, cellulis minutis; hypothecio decolore ex hyphis intricatis formato; hymenio subdecolore, superne obscure cinnamomeo-fusco, I intense coeruleo, demum obscurato; paraphysibus conglutinatis, simplicibus, septatis, ad apices clavatis; ascis oblongo-clavatis, hymenio subaequilongis, 8-sporis; sporis decoloribus, ellipsoideis vel ovali-subfusiformibus, primum 3–septatis, demum depauperato-muralibus, 18–27 μ longis et 7–12 μ latis.

Species habitu collemaceo et sporis pauciseptatis distincta.

On earth at the base of a northward-facing basaltic cliff.

Heppia placodizans A. Zahlbr. sp. nov.

Thallus in centro verruculoso-squamulosus, in margine effiguratus, olivaceo- vel umbrino-fuscus, opacus, KHO–, $CaCl_2O_2$–, squamulis centralibus plus minus congestis, parvis, 0.2–0.25 mm. latis, subtus fuscis, rotundis vel rotundatis, alte convexis vel semiglobosis, hyphis medullaribus centralibus substrato affixis, lobis marginalibus ad 2 mm. longis, angustis, subcylindricis, semel vel iteratim furcatis, contiguis, omnino pseudoparenchymaticus, cel-

lulis parvis angulosis, leptodermaticis, gonidiis scytonemeis, cellulis rotundatis vel late ovalibus, 7–8 μ longis, membrana tenuissima cinctis. Apothecia punctiformia, parum visibilia, immersa; disco impresso, punctiformi, nigricante et opaco; perithecio proprio non evoluto; hypothecio decolore, ex hyphis intricatis formato; hymenio decolore, solum superne olivaceo, 120–130 μ alto, I rufescente, imprimis ascis; paraphysibus increbris, simplicibus, latiusculis, ad 3.5 μ crassis, leptodermaticis, apicem versus tenuiter constricto-septatis; ascis hymenio subaequilongis, oblongo-clavatis, apicibus rotundatis vel angustato-rotundatis, membrana ibidem valde et calyptratim incrassata cinctis, myriosporis; sporis decoloribus, simplicibus, globosis, membrana tenuissima cinctis, 3.5–3.7 μ latis. Conceptacula pycnoconidiorum immersa, globosa; perithecio pallido; fulcris exobasidialibus; basidiis filiformibus, in parte inferiore paulum latioribus, pycnoconidiis multum longioribus; pycnoconidiis ovalibus, ovali-oblongis vel oblongis, ad 2 μ longis.

Species distincta, thallo placodiali et sectionem propriam format. Haec sectio nominanda est **Placoheppia** A. Zahlbr.

On basaltic boulders.

Heppia deserticola A. Zahlbr. sp. nov.

Thallus cervinus, opacus, KHO–, $CaCl_2O_2$–, squamosus, squamis demum plus minus congestis, 0.6–2 mm. altis, e rotundato sat irregularibus, subplanis, tenuibus, ad 0.2 mm. altis, in margine demum breviter inciso-lobatis, gompho centrali substrato affixis, subtus caeterum fuscis, omnino pseudoparenchymaticis, cellulis angulosis, leptodermaticis, gonidiis scytonemeis fere totam crassitudinem thalli occupantibus et solum in parte basali thalli anguste deficientibus. Apothecia in squamis solitaria, demum dilatata, usque 0.8 mm. lata, immersa; disco thallum subaequante, parum concavo vel subplano, rufescenti-nigricante, opaco, margine thallino angustissimo integro parum prominulo cincta; perithecio non evoluto; epithecio olivaceo-fusco, KHO rufo; hymenio dilute rosaceo, 160–170 μ alto, I vinose rubente; hypothecio angusto, decolore, non pseudoparenchymatico; paraphysibus tenuibus, strictis-filiformibus, simplicibus; ascis hymenio aequilongis, oblongo-clavatis, myriosporis; sporis decoloribus, simplicibus, heteromorphis, late ovalibus vel late ellipsoideis ovalibus, oblongis vel ovali-oblongis, membrana tenuissima cinctis, 7–11 μ longis et 3.5–5 μ latis.

Accedit ad *Heppiam leptopholidem* Nyl. et *Heppiam Hassei* A. Zahlbr., a priore distat squamis non nigro-marginatis et sporis non globosis, a posteriore thallo pallidiore et sporis longioribus polymorphisque.

On basaltic boulders.

K. K. NATURHISTORISCHES HOFMUSEUM, WIEN.

Two new grasses from the West Indies

GEORGE V. NASH

Panicum Grisebachii sp. nov.

A perennial with long branching creeping stems, long lanceolate leaf-blades, and rather small panicles. Stems smooth and glabrous, the lower nodes rooting : leaf-sheaths on the lower parts of the stem and branches shorter than the internodes, on the upper portions overlapping, hispid with ascending hairs, ciliate on the margins ; ligule a narrow scarious ring about 0.5 mm. wide ; blades ascending, 6–12 cm. long, up to 1 cm. wide, lanceolate, long-acuminate at the apex, somewhat narrowed toward the rounded base, glabrous on the upper surface, shortly pubescent on the lower : panicle 5–10 cm. long, minutely pubescent, its ascending branches 2–3 cm. long and usually bearing but few spikelets : spikelets finally becoming black, 4–4.5 mm. long, 3–4 mm. broad, the first scale a little less than one half as long as the spikelet, orbicular, apiculate, 7–9-nerved, villous at the apex, clasping the base of the spikelet, the second scale orbicular, 7–9-nerved, villous at the obtuse apex, the third scale orbicular, obtuse, 9–11-nerved, enclosing a palet, the fourth scale chartaceous, enclosing a palet of similar texture and a perfect flower.

At present this is known only from Cuba. Type specimen collected in the vicinity of Madruga, by Britton & Shafer, *no. 758*, March 28, 1903, in the herbarium of the New York Botanical Garden. I would also refer here the following : *Baker 3817*, Pinar del Rio, October 28, 1904 ; *Rugel 187*, Matanzas, 1849 ; *Wright 3457*.

This is the Cuban plant which has been commonly but erroneously referred to *Panicum martinicense* Griseb. That is quite another grass, differing in its erect habit, broader leaf-blades, and pointed spikelets.

Pharus parvifolius sp. nov.

A perennial grass with branching stems which creep extensively and root at the lower nodes, and small elliptic-lanceolate leaf-blades which are broadest below the middle. Stems shortly villous, especially above : leaves numerous ; sheaths smooth and glabrous, over-

lapping; ligule a lacerated scarious ring about 1 mm. wide; blades 6–12 cm. long, 1.5–3 cm. wide, on petioles up to 1.5 cm. long, elliptic-lanceolate, rounded or somewhat cuneate at the base, long-acuminate at the apex, smooth and glabrous, with 3 or 4 rather indistinct primary nerves on each side of the midrib: panicle shortly villous, finally much exserted, consisting usually of a single branch which is longer than the main axis of the panicle: staminate spikelets 2.5–3 mm. long, glabrous: pistillate spikelets 10–12 mm. long, the empty scales about one half as long as the spikelet, the flowering scale 10–12 mm. long, cylindric, often somewhat curved, densely glandular-pubescent with spreading hairs, excepting the somewhat obtuse, short-cuneate apex.

This interesting plant is at present known from Haïti, Cuba, and Porto Rico. Type specimen collected by the writer in deep shade in a ravine called Les Roches, a few miles to the west of Plaisance, Haïti, on August 11, 1905, at an altitude of about 540 meters, *Nash & Taylor 1482*, in the herbarium of the New York Botanical Garden. The following specimens are also referred here: *Maxon 4155*, near Jaguey, Yateras, Oriente, Cuba, April 24, 1907, 420–510 meters; *Eggers 4939*, Loma del Jaguey, Cuba, March, 1889, 800 meters; *Sintenis 6308*, Arecibo, Porto Rico, February 28, 1887 (sterile).

In the character of the spikelets, this is related to *Pharus glaber* H.B.K. It is, however, at once distinguished by its habit, this having a long creeping stem which branches at intervals, the plants thus forming large open mats, a feature quite unusual in the genus. The leaf-blades are also quite different in size and shape, being broadest below the middle and long-acuminate, whereas in *P. glaber* they are broadly oblanceolate-elliptic, that is, broadest above the middle, and much larger. The writer saw the two species growing together in Haïti, and the differences of habit and leaf-blade are very marked. In addition to the above differences, the panicle of the new species is much smaller, and usually reduced to a single branch, giving the appearance of a panicle broader than long.

NEW YORK BOTANICAL GARDEN.

The generic name Bucida

N. L. Britton

The name *Bucida* was proposed by Linnaeus in 1759 (Syst. ed. 10, 1025) for the *Buceras* of P. Browne (Civil and Nat. Hist. Jam. 221), published three years previously. Both names are derived from the fancied resemblance of certain outgrowths from

FIGURE 1. Hypertrophied fruit of *Bucida Buceras*, one half the natural dimensions.

the inflorescence of the tree to the horns of a bull, as expressed by P. Browne as follows: "On the flower-spikes of this tree you may sometimes find one or more fructifications, that shoot into a

monstrous size, being seldom under three inches in length, though never above a line and a half in diameter; and something in the form of a bull's horn."

The tree, known in Jamaica as the black olive, is valuable for its timber and grows commonly in swamps and along streams near the coast throughout the West Indies, extending north to south Florida and the Bahamas.

While boating on the Ferry River, a few miles west of Kingston, Jamaica, one of the places where Browne studied this tree, in company with Mr. William Harris, on April 10, 1908, I was much interested in observing a tree whose limbs hung over the water, bearing quantities of the structures referred to by Browne as "fructifications," and I easily obtained good specimens from it. On this tree the peculiar outgrowths are borne near the ends of the spikes, as illustrated by Browne on his plate 23, fig. 1; they are linear, elongated, and vary from 8 to 16 cm. in length, with a diameter of from 2 to 3 mm. when young, characteristically curved and very nearly circular in cross-section; when old, they split irregularly along one side, after becoming about 4 mm. in diameter, and expose a black internal mass, which suggested to me a possible fungal origin of the outgrowth; I requested Dr. Murrill to examine the specimens, but he could find no fungus, though he did find mites, whereupon we sent specimens to Professor Mel. T. Cook, who has recently furnished us with the following account of his examination of them. The accompanying figure represents a typical form of these interesting galls, remaining attached to the upper end of the inflorescence after the fruits have fallen away.

NEW YORK BOTANICAL GARDEN.

The hypertrophied fruit of Bucida Buceras

MELVILLE THURSTON COOK

Specimens of the enlarged fruits of *Bucida Buceras* were recently sent to me from the New York Botanical Garden by Dr. W. A. Murrill for examination and my attention was called to the fact that they contained mites in considerable numbers. The material was collected in Jamaica by Dr. N. L. Britton.

FIGURE 1. *A*, outline of normal fruit of *Bucida Buceras*, 1¼ natural size; *B*, outline of galled fruit of *Bucida Buceras*, 1¼ natural size.

A careful examination of the material confirmed the observations of the workers in the New York Botanical Garden and also convinces me that the hypertrophy is due to mites and may be considered as a fruit-gall produced by the action of an undescribed species of *Eriophyes*.

An anatomical study of these enlarged fruits and comparison with the anatomy of the normal fruits present the following facts: The fibro-vascular tissues are increased in quantity but otherwise are unchanged. The parenchyma tissue was increased in quantity and also formed into great numbers of papilla-like growths (FIGURE 2) which projected into and practically filled the ovarian chamber to the sacrifice of the seeds. At the base of the pod these parenchyma-cells had evidently reached their maximum of growth and were undergoing degeneration. They contained considerable quantities of yellowish-brown

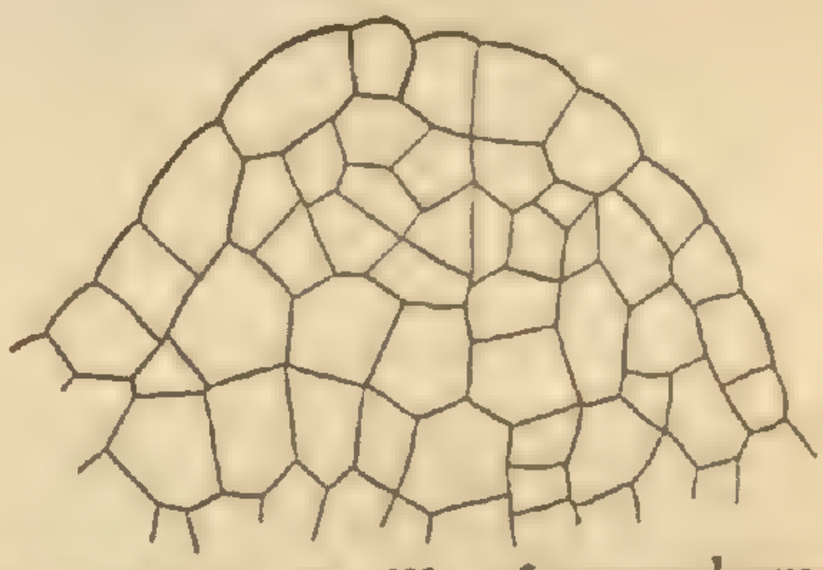


FIGURE 2. Papilla of parenchyma from ovary chamber.

substance, a part of which was tannin. Near the tip of the pod the cells were clear and evidently in a very active growing condition. The intermediate cells showed every stage between those of the two ends.

The mites were scattered throughout but were much more abundant near the tip than in any other part. Furthermore, many of those near the tip were smaller than those near the base.

Several species of mites produce hypertrophied conditions in plants grading from a simple erinium to well-defined galls. The simplest erinium may consist of unicellular outgrowths from the epidermis while the more complex forms develop masses of multicellular trichomes which are frequently accompanied with swellings of the parts from which they arise. In some instances the normal organs of the plant (usually the leaves of floral organs) become very much convoluted, while in other cases there is a swelling in which there is a well-defined cavity containing the mites. In most cases there are numerous papilla-like growths of the parenchyma projecting into these cavities.

When these hypertrophies reach a maximum growth, there is always a deposit of tannin. At this time the mites migrate towards the tip and attack the young and more actively growing parts.

From this discussion it will be readily seen that the anatomical character of these abnormal fruits corresponds with those of the well-defined *Eriophyes* galls.

AGRICULTURAL EXPERIMENT STATION,
NEWARK, DELAWARE.

Color variation in some of the fungi

FRED JAY SEAVER

The present short paper is the outgrowth of a year spent at the New York Botanical Garden as Columbia University fellow in botany, during which a large amount of time was spent in the study of the North American Hypocreales, the main results of which are still unpublished. The order Hypocreales belongs to the group of fungi commonly known as the Pyrenomycetes and is distinguished from the other orders of the group by the absence of black color. Instead of the black charcoal-like appearance the plants of the order show almost every conceivable shade, the individuals as a whole probably being more brilliantly colored than those of any other group of fungi and doubtless rivaling, in this respect, any other group of plants. But notwithstanding their brilliant colors, many of the plants of the order are so small and occur in such unexpected places that they escape the eye of the casual observer and often that of the more trained collector as well.

Probably no character is of more importance, if properly used, in the determination of species among the fungi than that of color, and at the same time no character has been so sadly misused. More synonyms in the present order owe their origin to lack of knowledge of the amount of variation of color in the various species of the order than to any other one fact. To describe a new species of maple which is distinguished from some of the species already described by the fact that the leaves are red instead of green would be considered absurd by students of higher plants, yet many species of fungi have been "made" on characters which are just as striking and also just as valueless as the one just suggested. The few corrections which are set forth here are made, not in the spirit of criticism, but with the hope that they may prevent some of the similar errors which otherwise might occur in the future. It is much more difficult to study the life-history of plants which are but a fraction of a millimeter in diameter than that of the higher plants which stand often many meters in height. Yet, if the existence of

these minute organisms is worthy of record at all, as the true lover of science will admit they are, they should deserve just as careful study through all the phases of their life history as do the higher plants, which on account of their large size force themselves upon our attention.

One of the first observations of color variation to come under the eye of the writer was in connection with the study of *Nectria purpurea* (L.) W. & S. (Jour. Myc. **13**: 51), which is more commonly known under the name *Nectria cinnabarina* (Tode) Fries. While collecting in the vicinity of Mt. Pleasant, Iowa, on November 10, 1905, a brush pile was found to be almost entirely covered with the plants of this species, which showed the characteristic cinnabar-red color and a collection of the material was made at this time. A few months later the same spot was visited again with the hope of making a second collection of the same species. The old plants still persisted but were so changed in color as to be scarcely recognizable, the perithecia having become very dark brown and in some cases entirely black. A second collection was made at this time and when compared with the first showed such a marked difference that, were color alone considered, they would constitute two well-defined species. Yet, these two specimens were known to represent the same species collected at different times. A careful study of this species in the laboratory and field has shown the range of coloration to be from bright cinnabar-red when collected in good condition to dull red, light brown, dark brown and finally black, with an infinite number of intermediate shades, the change coming about through weathering and varying conditions of moisture. The originally bright color of the plants and their xerophytic nature, which enables them to persist for a long time, often several months, after maturity, are sufficient to explain the cause of these variations.

In working over the various species of the genus *Nectria* preparatory to a monograph, several species which had been recorded in previous North American monographs had been tabulated in the notes of the writer as "suspicious characters" on the ground that the descriptions were too brief and indefinite to give any conception as to the real nature of the specimens described and in most cases gave no character which could be considered as dis-

tinctive of the species except color, which in this genus is very uncertain. Several of the species belonging to the doubtful list were from the notorious "B. & C." collections. In every case an attempt has been made to gain access to the type specimen of such species. Through the authorities of the New York Botanical Garden we have succeeded in securing several cotype specimens from the Royal Botanic Gardens at Kew and here it might be well to acknowledge the liberality and promptness with which such requests were granted by those in charge of the Botanic Gardens of England. Where specimens were too fragmentary to divide, pencil sketches were carefully prepared which have aided much in shedding light on some of the mysteries surrounding the group under consideration, although drawings do little to clear up the color question.

Some of the doubtful species of which the cotypes have been examined are *Nectria Russellii* B. & C., *Nectria offuscata* B. & C., and *Nectria nigrescens* Cooke. The first two were originally described in the following manner (Grevillea **4**: 45): "Cespitose, red inclined to brown, finally collapsing; spores cymbiform, 1-septate, 15 to 20 mic. long," and "Cespitose, dingy red-brown, minutely granulated, ostiolum depressed; asci clavate; spores 2-seriate oblong, 4 times as long as broad." In neither of these descriptions is there a single character mentioned which would distinguish the supposed species from *Nectria purpurea* (L.) W. & S., when the range of coloration of this species is taken into consideration, and a careful examination of the cotype specimens of each of these species also fails to reveal any valid specific character. The third of these doubtful species is described (Grevillea **7**: 50) as follows: "Cespitose, red, at length turning black, smooth, ostiolum papilliform; asci cylindrical, spores elongated-elliptical, 1-septate, 18 by 6 mic.; stylospores on the same stroma, some ovate brown (5 by 3 mic.), others linear (6 by 2 mic.), hyaline." The only character in this description which might mark a new species is the presence of the brown stylospores and there is no evidence given that these are connected with this plant even though present on the same stroma. Examination of a specimen of this species from Kew shows unmistakable evidence of age and partial decay. The perithecia are blackened and in many cases crumbled and it is dif-

ficult to find asci and spores, all of which are indications of the age of the specimens at the time of collection. The brown stylospores mentioned in the description were not seen and even though present, as suggested above, there is no evidence that they form a part of the life-history of the plant with which they are found. The specimen has every appearance of being a discolored specimen of *Nectria purpurea* (L.) W. & S.

Nectria Meliae Earle (Bull. Torrey Club **25**: 364) is said in the original description to be distinguished from *Nectria purpurea* (L.) W. & S. by the darker color of the perithecia and a slight variation in size. Examination of specimens of this species in the herbarium of the New York Botanical Garden shows no grounds for its separation.

No species deserves more careful study than the one now under consideration for the reasons that it is common and widely distributed, occurs on nearly every kind of tree and shrub, and, being a persistent form, shows much variation in color as well as in other characters which would naturally be affected with age. A large number of the closely related so-called species which have been described are distinguished primarily on color and if every shade of color be accepted as a valid specific character we might have an infinite number of "printer's ink" species created from the one form as set apart by nature.

Another case of color variation has been noted in *Hypocrea gelatinosa* (Tode) Fries (Fung. Meckl. Sel. **2**: 46. *f. 123, 124*). Specimens of this species collected by the writer show the very young plants to be of a bright lemon-yellow color, but as the spores mature they become olive-green, giving to the stroma a mottled appearance. The whole stroma then becomes darker until it assumes a dirty green, finally becoming nearly black with age. In fresh specimens all of these variations have been seen on the same substratum and the relation can be traced from one to the other.

Hypocrea chlorospora B. & C. (Grevillea **4**: 14) is characterized as being distinguished from the above by the black stroma, the color of the spores being the same in both species. While no authentic specimen of this species could be secured, it seems very doubtful if it is distinct from *Hypocrea gelatinosa* (Tode) Fries.

In the Ellis collection at the New York Botanical Garden is a specimen of green-spored *Hypocrea* labeled, evidently in the handwriting of Mr. Ellis, "*Hypocrea viridis* n. s." and the stroma described as being dull greenish within and without, and a note is added stating that it could not be *Hypocrea chlorospora* B. & C. for the reason that that species was characterized by a black stroma. Another note, added, apparently, at some later time, stated that as the plant dried it became darker and might after all be *Hypocrea chlorospora* B. & C.

Still another specimen of green-spored *Hypocrea* was described by Mr. Ellis as being at first yellowish. Both of these specimens when examined in 1906 showed the stromata to be entirely black with a greenish bloom, which came about from the dusting out of the spores from the perithecia.

The notes on the specimens in the Ellis collection, as well as the observations of the writer on both herbarium and fresh material which has been collected often and in various localities, tend to confirm the opinion that *Hypocrea chlorospora* B. & C. is identical with *Hypocrea gelatinosa* (Tode) Fries and that the range of coloration in this species is from bright golden or lemon-yellow in very young specimens to dirty greenish as the spores mature and finally black with a greenish bloom, which comes from the dusting out of the spores from the perithecia as the specimens become more aged.

This view is strengthened by the fact that Tode in his original description recognized two varieties, *viridis* (green) and *lutea* (yellow), and Fries later recognized a third, *umbrina* (dark).

Hypocrea apiculata Cooke & Peck (Ann. Rep. N. Y. State Mus. **29**: 57) also shows some rather marked color changes. This species has been studied from numerous collections of fresh material, the identification of which has been confirmed by Mr. Peck, one of the authors of the species. In specimens collected in good condition the stromata are of a bright orange-yellow color. If specimens are dried and exposed to the light for some time the color becomes lighter until it assumes a dirty yellowish and finally becomes almost white or a dirty yellowish-white. In this case the bleached specimen might easily be mistaken for a distinct species considering the importance which has usually been attached to the color character in this genus.

One of the most striking cases of color variation has been observed in *Hypomyces lactifluorum* (Schw.) Tul. (Syn. Fung. Car. 4). This species has been studied from various exsiccati in the herbarium of the New York Botanical Garden, including both American and foreign specimens and during the past season ample opportunity has been afforded to carry on field observations with the same species.

Hypomyces purpureus Peck (Bull. Torrey Club **25**: 327) is stated in the original description to differ from *Hypomyces lactifluorum* (Schw.) Tul. only in the color of the stroma, which is purple instead of orange-yellow. Studies in the herbarium convinced the writer that the two species were identical, but for lack of suitable material the matter could not be demonstrated absolutely. From recent studies in the field the fact has been established beyond the shadow of a doubt.

During the last season in a piece of aspen timber on the Red River near Fargo, North Dakota, numerous specimens of *Lactaria* were found, all of which were entirely parasitized by *Hypomyces lactifluorum* (Schw.) Tul. The normal color of the plants of this species is a bright orange-yellow and the striking character of the color might be illustrated by the following incident: The collector on returning from a collecting trip with a basket partially filled with the plants of this species chanced to pass a vehicle in which a little boy was heard to remark to his mother "O mama, see the big basket of orange peel!" While most of the specimens collected showed the normal orange color, in looking over the field a number were noted which showed the purple color characteristic of *Hypomyces purpureus* Peck. But in every such case the host showed evidences of decay and in advanced cases the host had become soft and fallen in a heap. In these extreme cases of decay the purple color was very prominent and would readily suggest to the mind of the collector the association of the purple color with decay.

In order to test the matter a simple experiment was conducted. A plant which showed the normal orange-yellow color was selected and cut into two pieces. The one was placed in a moist chamber and the other dried at once. As the moist specimen decayed, it assumed the characteristic purple color of *Hypomyces purpureus*

Peck and the other half which was dried immediately retained the orange-color of *Hypomyces lactifluorum* (Schw.) Tul. thus proving the identity of the two species. Dried specimens of each were mounted in the herbarium of the writer and kept for future reference.

Colors are not equally changeable in all cases, neither are the conditions which bring about these changes the same for different species. In *Hypocrea citrina* (Pers.) Fries, which is normally of a bright lemon-yellow color, the dried specimens have been exposed to the light for several months and no change in color detected, while specimens of *Hypomyces apiculata* Cooke & Peck are entirely bleached when treated in the same manner. However, *Hypocrea citrina* (Pers.) Fries, if exposed to conditions of excessive moisture, loses its bright color and takes on a dull yellow, approaching a brown.

The conclusions of the present paper are that the evidence, which is adequate in most cases, suggests the reduction of the following species which are based primarily on color to the list of synonyms: *Nectria Russellii* B. & C., *Nectria offuscata* B. & C., *Nectria nigrescens* Cooke, and *Nectria Meliae* Earle, being based on aged and more or less discolored specimens of *Nectria purpurea* (L.) W. & S.; *Hypocrea chlorospora* B. & C. on an aged specimen of *Hypocrea gelatinosa* (Tode) Fries; and *Hypomyces purpureus* Peck a condition of *Hypomyces lactifluorum* (Schw.) Tul. in process of decay. Further, that the description of new species in the present order based on color *alone*, until the color variation of the various species or the order can be determined, leads to nothing but confusion. Only a few of the more striking cases of color variation have been mentioned here and those with the hope of impressing upon co-workers the necessity of more careful field study rather than a haphazard description of new species based on characters which may prove constant but which in many cases are most changeable.

A monograph of the North American Hypocreales is in course of preparation by the writer and material is desired from any part of North America.

In preparing this paper I am indebted to the New York Botanical Garden for unrestricted use of library and herbarium,

including the Ellis collections, and to the Royal Botanic Gardens of England for the several cotype specimens referred to in the paper; also to Mr. C. H. Peck for the determination of one species used and to the late L. M. Underwood for suggestions on various points.

NORTH DAKOTA AGRICULTURAL COLLEGE,
AGRICULTURAL COLLEGE, NORTH DAKOTA.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1907)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions their kindness will be appreciated.

This Index is reprinted monthly on cards, and furnished in this form to subscribers, at the rate of one cent for each card. Selections of cards are not permitted; each subscriber must take all cards published during the term of his subscription. Correspondence relating to the card-issue should be addressed to the Treasurer of the Torrey Botanical Club.

Bergon, P. Biologie des diatomées. — Les processus de division, de rajeunissement de la cellule et de sporulation chez le *Biddulphia mobiliensis* Bailey. Bull. Soc. Bot. France **54**: 327–358. *pl. 5–8. 14.* Au 1907.

Borgesen, F. An ecological and systematic account of the caulerpas of the Danish West Indies. Kong. Dansk. Vid. Selsk. Skr. VII. **4**: 337–392. *f. 1–31.* 1907.

Bouly de Lesdain, M. Notes lichénologiques. Bull. Soc. Bot. France **54**: 442–446. 14 Au 1907.
Includes one new Peruvian species.

Brown, S. Alpine flora of the Canadian Rocky Mountains. i–xxxix + 1–353. New York, 1907. [Illust.]

Campbell, D. H. Studies on the *Ophioglossaceae.* Ann. Jard. Bot. Buitenz. II. **6**: 138–194. *pl. 9–19.* 1907.

Christman, A. H. The nature and development of the primary uredospore. Trans. Wisconsin Acad. **15**: 517–526. *pl. 29.* 1907.

Clos, D. *Quamoclit* et *Ipomoea.* Bull. Soc. Bot. France **54**: 380–384. 14 Au 1907.

Cockerell, T. D. A. The genus *Crataegus* in Colorado. Univ. Colorado Stud. **5**: 41–45. D 1907.

Cook, O. F. Mendelism and other methods of descent. Proc. Washington Acad. Sci. **9**: 189–240. 31 Jl 1907.

Cook, O. F. Origin and evolution of angiosperms through apospory. Proc. Washington Acad. Sci. **9**: 159–178. 31 Jl 1907.

Copeland, E. B. A revision of *Tectaria* with special regard to the Philippine species. Philipp. Jour. Sci. **2**: 409–418. D 1907.

Copeland, E. B. Notes on the Steere collection of Philippine ferns. Philipp. Jour. Sci. **2**: 405–407. D 1907.

Copeland, E. B. Some new and critical ferns. Leaflets Philipp. Bot. **1**: 233–235. 6 N 1907.

Corrêa, M. P. Algumas madeiras e diversos vegetaes uteis do Brazil. A Lavoura. Bol. Soc. Nac. Agr. [Brazil] **11**: 403–419. S 1907; 479–490. O 1907; 562–569. N 1907.

Cushman J. A. New England species of *Penium*. Rhodora **9**: 227–234. 30 D 1907.

Cushman, J. A. *Primula farinosa*, var. *macropoda* on the Maine coast. Rhodora **9**: 217, 218. 10 D 1907.

Davenport, C. B. Heredity and Mendel's law. Proc. Washington Acad. Sci. **9**: 179–187. 31 Jl 1907.

Davis, J. J. Mycological narrative of a brief journey through the Pacific Northwest. Trans. Wisconsin Acad. **15**: 775–780. D 1907.

Denniston, R. H. The growth and organization of the starch grain. Trans. Wisconsin Acad. **15**: 664–708. *pl. 38–40.* 1907.

Dobbin, F. Rediscovery of *Podostemon ceratophyllus* in Vermont. Rhodora **9**: 220. 10 D 1907.

Eames, E. H. A new variety of *Scirpus Olneyi*. Rhodora **9**: 220. 10 D 1907.

Elmer, A. D. E. A fascicle of Tabayas figs. Leaflets Philipp. Bot. **1**: 236–261. 15 N 1907.

Elmer, A. D. E. *Freycinetia* from Lucuban. Leaflets Philipp. Bot. **1**: 212–219. 14 O 1907.

Elmer, A. D. E. Some new *Leguminosae*. Leaflets Philipp. Bot. **1**: 220–232. 21 O 1907.

Fernald, M. L. Some new willows of eastern America. Rhodora **9**: 221–226. 30 D 1907.
Includes 3 new species of *Salix*.

Foxworthy, F. W. Philippine woods. Philipp. Jour. Sci. 2: 351–404. O 1907.

[Gibson, H. H.] American forest trees — 44. Shortleaf or yellow pine, *Pinus echinata* Mill., *Pinus mitis* Michx. Hardwood Record 23[6]: 16, 17. 10 Ja 1907. [Illust.]

[Gibson, H. H.] American forest trees — 45. Slippery elm. *Ulmus fulva* Michx., *Ulmus pubescens* Walt. Hardwood Record 23[7]: 16, 17. 25 Ja 1907. [Illust.]

[Gibson, H. H.] American forest trees — 46. Hardy catalpa, *Catalpa speciosa* Warder. Hardwood Record 23[8]: 16, 17. 10 F 1907. [Illust.]

[Gibson, H. H.] American forest trees — 47. Butternut, *Juglans cinerea* Linn. Hardwood Record 23[9]: 16, 17. 25 F 1907. [Illust.]

[Gibson, H. H.] American forest trees — 48. Bur oak, *Quercus macrocarpa* Michx. Hardwood Record 23[10]: 16, 17. 10 Mr 1907. [Illust.]

[Gibson, H. H.] American forest trees — 49. Honey locust, *Gleditsia triacanthos* Linn. Hardwood Record 23[11]: 16, 17. 25 Mr 1907. [Illust.]

[Gibson, H. H.] American forest trees — 50. Coffee tree, *Gymnocladus dioicus* Koch. Hardwood Record 23[12]: 17, 18. 10 Ap 1907. [Illust.]

[Gibson, H. H.] American forest trees — 51. Pignut, *Hicoria glabra* Britton. Hardwood Record 24[1]: 16, 17. 25 Ap 1907. [Illust.]

[Gibson, H. H.] American forest trees — 52. Pin oak, *Quercus palustris* Muench. Hardwood Record 24[2]: 16. 10 My 1907. [Illust.]

[Gibson, H. H.] American forest trees — 53. Chinquapin oak. *Quercus acuminata* Sarg. Hardwood Record 24[3]: 16, 17. 25 My 1907. [Illust.]

[Gibson, H. H.] American forest trees — 54. White cedar, *Chamaecyparis sphaeroides* Spach, *Chamaecyparis thyoides* Britt. Hardwood Record 24[4]: 16, 17. 10 Je 1907. [Illust.]

[Gibson, H. H.] American forest trees — 55. White willow, *Salix alba* Linn. Hardwood Record 24[5]: 16. 25 Je 1907. [Illust.]

[Gibson, H. H.] American forest trees — 56. Eucalyptus, *Eucalyptus globulus* Lab. Hardwood Record 24[6]: 16, 17. 10 Jl 1907. [Illust.]

[**Gibson, H. H.**] American forest trees — 57. Tupelo, *Nyssa aquatica* Linn. Hardwood Record **24**[7]: 16, 17. 25 Jl 1907. [Illust.]

[**Gibson, H. H.**] American forest trees — 58. Rock elm, *Ulmus racemosa* Thomas. Hardwood Record **24**[8]: 16, 17. 10 Au 1907. [Illust.]

[**Gibson, H. H.**] American forest trees — 59. White cedar or arborvitae, *Thuja occidentalis* Linn. Hardwood Record **24**[9]: 16, 17. 25 Au 1907. [Illust.]

[**Gibson, H. H.**] American forest trees — 60. Tamarack, *Larix laricina* Koch, *Larix americana* Michx. Hardwood Record **24**[10]: 16, 17. 10 S 1907. [Illust.]

[**Gibson, H. H.**] American forest trees — 61. Persimmon, *Diospyros virginiana* Linn. Hardwood Record 24[11]: 16, 17. 25 S 1907. [Illust.]

[**Gibson, H. H.**] American forest trees — 62. Dogwood, *Cornus florida* Linn. Hardwood Record **24**[12]: 16, 17. 10 O 1907. [Illust.]

[**Gibson, H. H.**] American forest trees — 63. Red or slippery elm, *Ulmus fulva* Michx. Hardwood Record **25**[1]: 16. 25 O 1907. [Illust.]

[**Gibson, H. H.**] American forest trees — 64. Redwood, *Sequoia sempervirens* Endl. Hardwood Record **25**[2]: 16, 17. 10 N 1907. [Illust.]

[**Gibson, H. H.**] American forest trees — 65. Douglas fir, *Pseudotsuga taxifolia* Britton. Hardwood Record **25**[3]: 16, 17. 25 N 1907. [Illust.]

[**Gibson, H. H.**] American forest trees — 66. Noble fir or Oregon larch, *Abies nobilis* Lindl. Hardwood Record **25**[4]: 16, 17. 10 D 1907. [Illust.]

[**Gibson, H. H.**] American forest trees — 67. Western or Pacific Coast cedar, *Thuja plicata* Don, *Thuja gigantea* Nutt. Hardwood Record **25**[5]: 16, 17. 25 D 1907. [Illust.]

Gürke, M. *Echinocereus Hempelii* Fobe. Monats. Kakteenk. **17**: 187, 188. 15 D 1907.

Gürke, M. *Mamillaria radians* P. DC. Monats. Kakteenk. **17**: 177–182. 15 D 1907.

Gürke, M. *Rhipsalis pilocarpa* Loefgr. Monats. Kakteenk. **17**: 182–184. 15 D 1907.

Harper, R. M. Special indexes to part I, article I. A phytogeographical sketch of the Altamaha Grit region of the coastal plain of Georgia. Ann. N. Y. Acad. Sci. **17**: 659–680.

Harper, R. M. Georgia's forest resources. Southern Woodlands 1^3: 4–23. Au 1907; 1^4: 1–19. O 1907; 1^5: 3–19. D 1907. [Illust.]

Hermann, F. Zur Einteilung der Gattung *Pedicularis*. Verhandl. Bot. Ver. Brandenb. **49**: 212. 30 S 1907.

Horne, W. T. Report on the coconut disease known as bud rot or heart rot. 1–8. Havana, 1907. [In English and Spanish.]

Kellerman, W. A. Description and illustration of Peck's *Psathyrella hirta*. Myc. Bull. **5**: 371, 373, 374. *pl. 276*. D 1907.

Knowlton, C. H. Noteworthy plants collected at Roque Bluffs, Maine, in 1907. Rhodora **9**: 218, 219. 10 D 1907.

Koehne, E. *Lythraceae*. Nachträge. Bot. Jahrb. **41**: 74–110. 20 D 1907.

Includes new species in *Cuphea* (8), *Nesaea* (2), and *Lagerstroemia* (3).

Lamb, A. B. A new explanation of the mechanics of mitosis. Jour. Exp. Zool. **5**: 27–33. *f. 1, 2*. N 1907.

Léveillé, H. Essai sur le genre *Jussiaea*. Bull. Soc. Bot. France **54**: 421–427. 14 Au 1907.

Mieckley, W. *Echinocactus Fobeanus* Mieckl. n. sp. Monats. Kakteenk. **17**: 187. 15 D 1907.

Olive, E. W. Cell and nuclear division in *Basidiobolus*. Ann. Myc. 5: 404–418. *pl. 10*. 25 N 1907.

Olive, E. W. Cytological studies on *Ceratiomyxa*. Trans. Wisconsin Acad. **15**: 753–774. *pl. 47*. D 1907.

Pease, A. S., & Moore, A. H. An alpine variety of *Houstonia caerulea*. Rhodora **9**: 209, 210. 10 D 1907.

Piper, C. V. New plants of the Pacific slope, with some revisions. Smithson. Misc. Coll. **50**: 195–202. 23 Au 1907.

Includes new species in *Orthocarpus*, *Lupinus*, *Castilleja*, and *Valerianella*.

Pulle, A. Neue Beiträge zur Flora Surinams — I. Rec. Trav. Bot. Néerland. **4**: 119–141. 1907.

Includes 3 new species, one each in *Oncidium*, *Virola*, and *Parkia*.

Purpus, A. *Echeveria cuspidata* Rose. Monats. Kakteenk. **17**: 184, 185. 15 D 1907. [Illust.]

Ramaley, F. The silva of Colorado — III. Woody plants of Boulder County. Univ. Col. Stud. **5**: 47–63. D 1907. [Illust.]

Reed, G. M. Infection experiments with the mildew on cucurbits, *Erysiphe cichoracearum* DC. Trans. Wisconsin Acad. **15**: 527–547. My 1907.

Rehm, H. Ascomycetes exs. fasc. 40. Ann. Myc. **5**: 465–473. 31 D 1907.

Includes 3 new species, one each in *Capnodium*, *Winterella*, and *Phyllachora*.

Rehm, H. Ascomycetes novi. Ann. Myc. **5**: 516–546. 31 D 1907.

Includes 49 new American species.

Riddle, L. W. *Notothylas orbicularis* in Massachusetts. Rhodora **9**: 219, 220. 10 D 1907.

Russel, H. Check list of the flora of Milwaukee County. Bull. Wisconsin Nat. Hist. Soc. II. **5**: 167–250. 1907.

Rydberg, P. A. Scandinavians who have contributed to the knowledge of the flora of North America. Augustana Libr. Proc. **6**: 1–49. 1907.

Sands, M. C. Nuclear structure and spore formation in *Microsphaera Alni*. Trans. Wisconsin Acad. **15**: 733–752. *pl. 46*. 1907.

Shull, G. H. Importance of the mutation theory in practical breeding. Proc. Am. Breed. Ass. **3**: 60–67. 1907.

Smith, G. D. Description and picture of *Calvatia elata* and *Sarcoscypha floccosa*. Myc. Bull. **5**: 367, 368, 370. *pl. 272, 273*. D 1907.

Stevens, A. B., & Warren, L. E. Poison sumac. Am. Jour. Pharm. **79**: 499–522. N 1907. [Illust.]

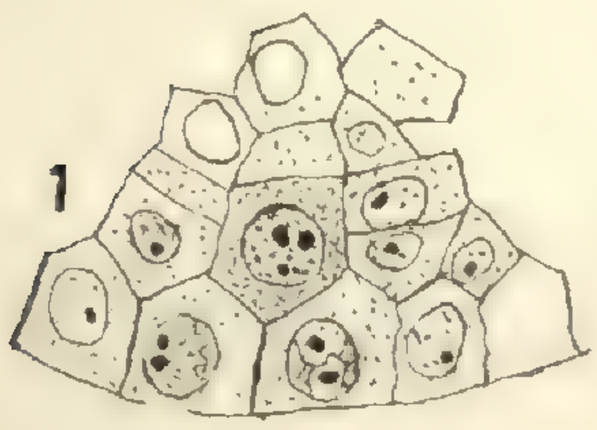
Stevens, F. L. Some remarkable nuclear structures in *Synchytrium*. Ann. Myc. **5**: 480–484. *pl. 13*. 31 D 1907.

Warnstorf, C. Neue europäische und aussereuropäische Torfmoose. Hedwigia **47**: 76–112. 30 S 1907.

Includes 14 new American species in *Sphagnum*.

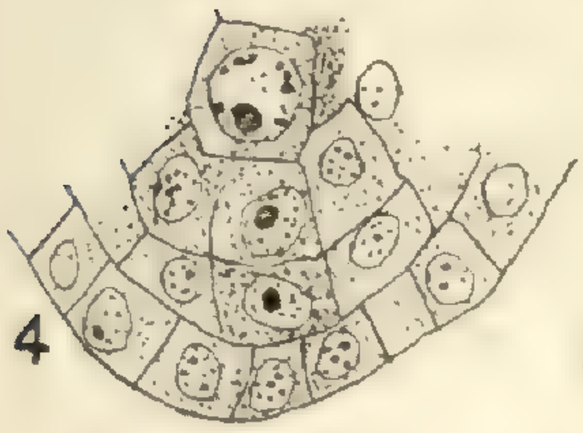
Wheeler, L. A. New stations for two Vermont plants. Rhodora **9**: 227. 30 D 1907.

Wight, W. F. A new larch from Alaska. Smithson. Misc. Coll. **50**: 174. *pl. 17*. 10 Jl 1907.

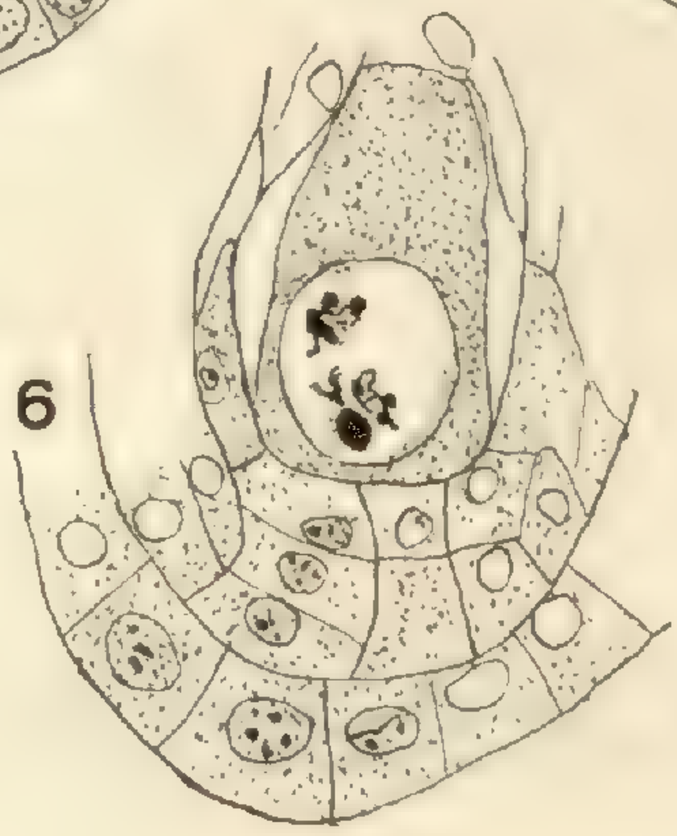

1

2

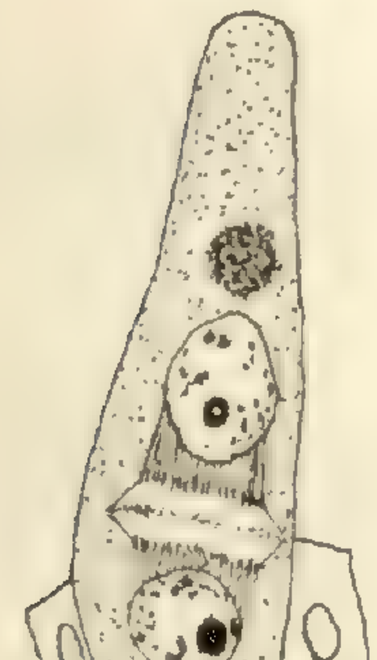
3


4

5


6

7

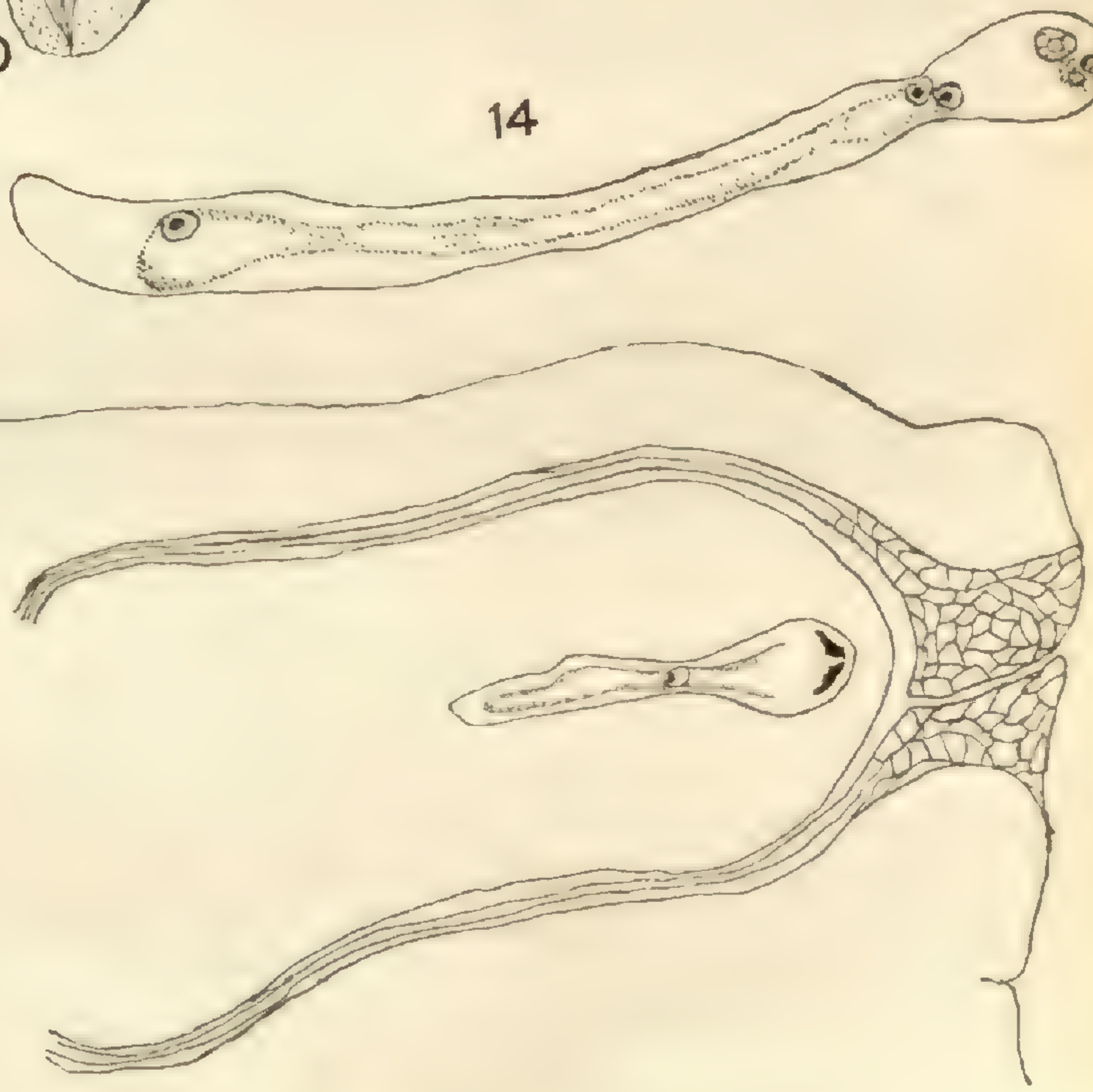

8

9

10

11

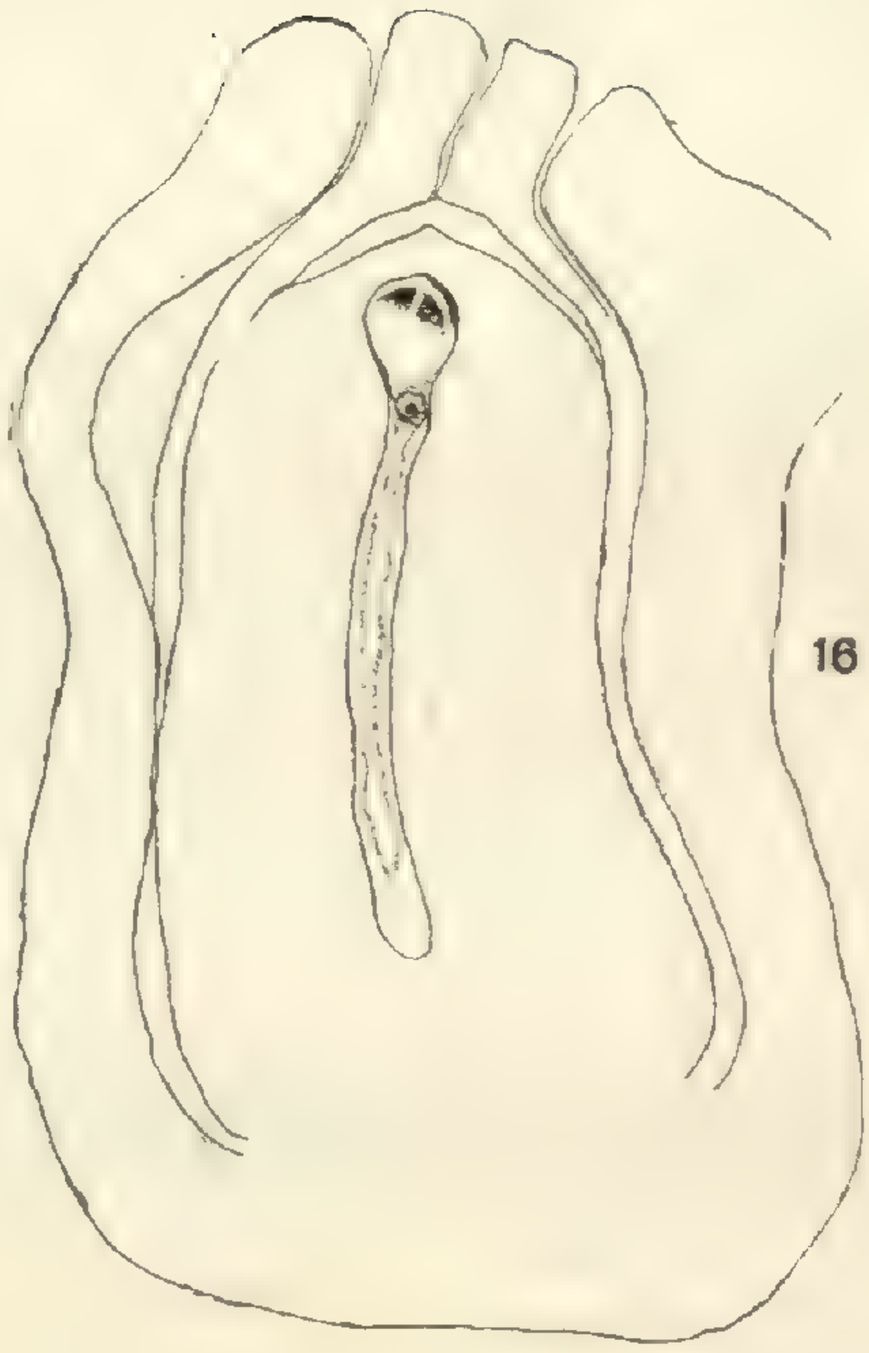
12

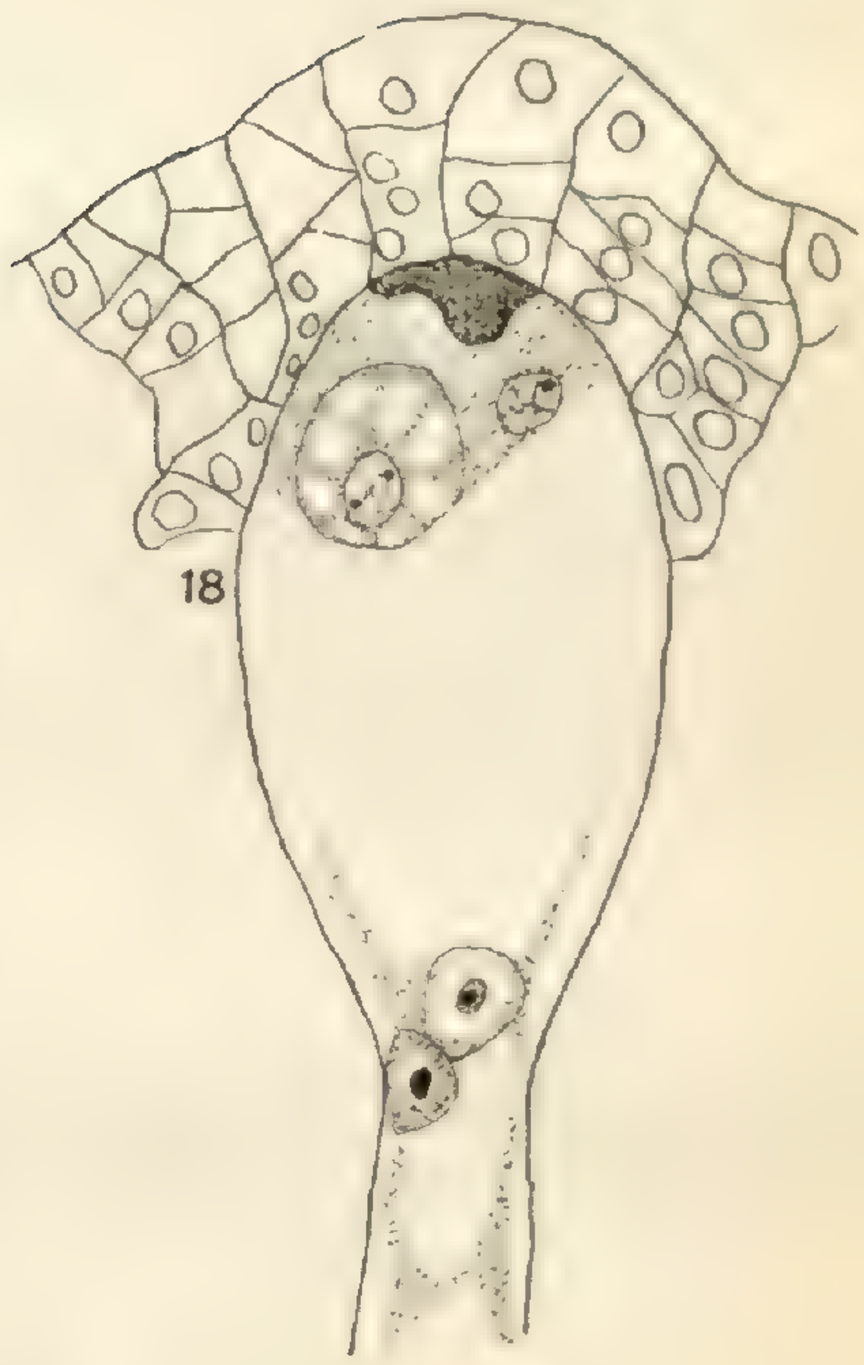

13

14

SEATON, EMBRYO-SAC OF NYMPHAEA ADVENA

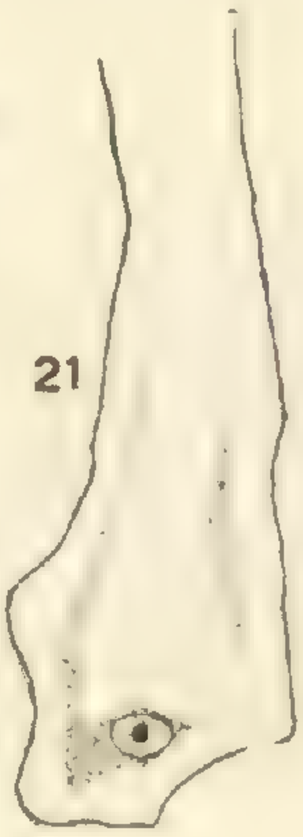
15


16


18

20

17


21

19

SEATON, EMBRYO-SAC OF NYMPHAEA ADVENA

LYCOPERDON SCULPTUM Harkness

THE BRYOLOGIST

WITH THE JANUARY, 1908, NUMBER BEGINS ITS

ELEVENTH YEAR AND VOLUME

It is a 16–20 page bi-monthly devoted to the study of the Mosses, Hepatics, and Lichens. It is fully illustrated with new, original, and artistic drawings and half-tones. It is indispensable to the working bryologist, professional as well as amateur. Send for sample copy. Subscription price $1.00 a year.

Address, MRS. ANNIE MORRILL SMITH, 78 Orange Street, Brooklyn, N. Y.

INDEX TO AMERICAN BOTANICAL LITERATURE

This Index, printed each month in the BULLETIN, is reissued on library catalogue cards; these are furnished to subscribers at the rate of one cent for each card.

Subscriptions to the card-issue may be addressed to the Treasurer of the Torrey Botanical Club,

WILLIAM MANSFIELD, COLLEGE OF PHARMACY, 115 W. 68th St., N. Y. City.

Beginning with January, 1903, the Index has also been reprinted on paper, on one side only, and can be furnished in that form at the rate of $3.00 a year.

North American Flora

THIS work is designed to present descriptions of all plants growing independent of cultivation, in North America, here taken to include Greenland, Central America, the Republic of Panama, and the West Indies, except Trinidad, Tobago, and Curaçao and other islands off the north coast of Venezuela, whose flora is essentially South American.

It will be published in parts at irregular intervals by the New York Botanical Garden through the aid of the income of the David Lydig Fund bequeathed by Charles P. Daly.

It is planned to issue parts as rapidly as they can be prepared, the extent of the work making it possible to commence publication at any number of points. The completed work will form a series of volumes with the following sequence:

Volume 1. Mycetozoa, Schizophyta, Diatomaceae.
Volumes 2 to 10. Fungi.
Volumes 11 to 13. Algae.
Volumes 14 and 15. Bryophyta.
Volume 16. Pteridophyta and Gymnospermae.
Volumes 17 to 19. Monocotyledones.
Volumes 20 to 30. Dicotyledones.

The preparation of the work has been referred by the Scientific Directors of the Garden to a committee consisting of Professors L. M. Underwood and N. L. Britton.

Professor George F. Atkinson of Cornell University, Professors Charles R. Barnes and John M. Coulter of the University of Chicago, Mr. Frederick V. Coville of the United States Department of Agriculture, Professor Edward L. Greene of the United States National Museum, Professor Byron D. Halsted of Rutgers College and Professor William Trelease of the Missouri Botanical Garden have consented to act as an advisory committee.

The subscription price is fixed at $1.50 for each part; it is expected that four or five parts will be required for each volume. A limited number of separate parts will be sold at $2.00 each. Address,

THE NEW YORK BOTANICAL GARDEN

BRONX PARK, NEW YORK CITY

Vol. 7. Part 1, Ustilaginales, including Ustilaginaceae and Tilletiaceae, by G. P. Clinton, was issued Oct. 4, 1906. Vol. 7, Part 2, Coleosporiaceae, Uredinaceae and Aecidiaceae (pars), of the Uredinales, by J. C. Arthur was issued March 6, 1907. Vol. 22, Part 1, including Podostemonaceae by George V. Nash, Crassulaceae by N. L. Britton and J. N. Rose, and Penthoraceae and Parnassiaceae by P. A. Rydberg, was issued May 22, 1905. Vol. 22, Part 2, including Saxifragaceae and Hydrangeaceae by J. K. Small and P. A. Rydberg, Cunoniaceae, Iteaceae, and Hamamelidaceae by N. L. Britton, Pterostemonaceae by J. K. Small, Altingiaceae by Percy Wilson and Phyllonomaceae by H. H. Rusby, was issued Dec. 18, 1905. Vol. 25, Part 1, including Geraniaceae, by L. T. Hanks and J. K. Small, Oxalidaceae and Linaceae by J. K. Small, and Erythroxylaceae by N. L. Britton, was issued Aug. 24, 1907. Vol. 9, Part 1, Polyporaceae (pars), by W. A. Murrill, was issued Dec. 19, 1907.

PUBLICATIONS BY OFFICERS AND STUDENTS OF THE DEPARTMENT OF BOTANY, COLUMBIA UNIVERSITY

1. MEMOIRS OF THE DEPARTMENT:

Vol. 1. A Monograph of the North American Species of the Genus *Polygonum* (1895). By John Kunkel Small, Fellow in Botany, 1893–1895; Curator of the Herbarium, 1895–1898.

Quarto, 178 pages, 84 plates. Price $6.00.

Vol. 2. A Monograph of the North American Potentilleae (1898). By Per Axel Rydberg, Fellow in Botany, 1896–7.

Quarto, 224 pages, 112 plates. Price $6.00.

2. CONTRIBUTIONS FROM THE DEPARTMENT:

Vol. 1. Nos. 1–25. 1886–1892. Price $5.00.
Vol. 2. Nos. 26–50. 1892–1894. Price $5.00.
Vol. 3. Nos. 51–75. 1894–1895. Price $5.00.
Vol. 4. Nos. 76–100. 1895–1896. Price $5.00.
Vol. 5. Nos. 101–125. 1896–1897. Price $5.00.
Vol. 6. Nos. 126–150. 1897–1898. Price $5.00.
Vol. 7. Nos. 151–175. 1898–1901. Price $5.00.
Vol. 8. Nos. 176–200. 1901–1902. Price $5.00.
Vol. 9. Nos. 201–. 1903–(current).

List of separate numbers available on application.

3. A Text-book of General Lichenology (1896). By Albert Schneider, Fellow in Botany, 1895–1896.

Octavo, 230 pages, 76 plates. Price $4.25 (cloth); $3.80 (paper). Published by Willard N. Clute & Co. Binghamton, N. Y.

The Department invites propositions relative to exchanges of herbarium material for any of the above named publications. Address Dr. Carlton C. Curtis, Columbia University, N. Y. City.

4. An Illustrated Flora of the Northern United States, Canada, and the British Possessions from Newfoundland to the Parallel of the Southern Boundary of Virginia, and from the Atlantic Ocean westward to the 102d Meridian (1896–1898). By Nathaniel Lord Britton, Professor of Botany, 1891–1896; Emeritus Professor 1896–, and Hon. Addison Brown.

Three volumes, royal octavo. Vol. 1, 612 pages; Vol. 2, 642 pages; Vol. 3, 588 pages; 4162 figures in the text, illustrating every species described.

Published by Charles Scribner's Sons, New York. Price, in cloth, $9.00 for the three volumes; with the indexes and keys bound separately, $10.00.

5. Our Native Ferns and their Allies. (Sixth Edition) 1900. By Lucien Marcus Underwood, Professor of Botany, 1896–1907.

Duodecimo, 158 pages, 35 figures. Published by Henry Holt & Co., New York. Price, $1.00.

6. Moulds, Mildews, and Mushrooms. By Lucien Marcus Underwood, Professor of Botany, 1896–1907.

Duodecimo, 236 pages, 10 plates. Published by Henry Holt & Co. Price $1.50.

7. Nature and Development of Plants (1907). By Carlton Clarence Curtis, Assistant in Botany, 1892–1895; Tutor in Botany, 1895–1906; Instructor in Botany, 1906–.

Octavo, 471 pages; 342 illustrations. Published by Henry Holt & Co., New York. Price $2.50.

ESTABLISHED 1851

EIMER & AMEND

205–211 Third Ave.,
Corner 18th Street

NEW YORK

MANUFACTURERS AND IMPORTERS OF

Chemicals and Chemical Apparatus

Our Specialties

MICROSCOPES
and
ACCESSORIES

MICROTOMES

BALANCES
and
WEIGHTS

Sole Agents for

C. A. F.
KAHLBAUM'S
C. P. Chemicals
and Reagents

CARL
SCHLEICHER
& SCHÜLL'S
C. P. Filters

SCHOTT &
GENOSSEN'S
Famous Laboratory Glassware

And for many other renowned European houses in our line.

COMPLETE LINE OF

Bacteriological Apparatus

WE HANDLE

EVERYTHING NEEDED FOR A LABORATORY

Inspection of premises cordially invited.

MEMOIRS OF THE TORREY BOTANICAL CLUB

A series of technical papers on botanical subjects, published at irregular intervals. Price $3.00 a volume. Not offered in exchange.

Vol. 1, No. 1; not furnished separately:

Bailey, Liberty Hyde. Studies of the types of various species of the genus *Carex*. Pages 1–85. 25 My 1889.

Vol. 1, No. 2; not furnished separately:

Martindale, Isaac Comly. Marine algae of the New Jersey coast and adjacent waters of Staten Island. Pages 87–111. 24 Au 1889.

Vol. 1, No. 3; price, 75 cents:

Spruce, Richard. *Hepaticae* Bolivianae, in Andibus Boliviae orientalis, annis 1885–6, a cl. H. H. Rusby lectae. Pages 113–140. 20 Ja 1890.

Vol. 1, No. 4; price, 75 cents:

Sturtevant, Edward Lewis. On seedless fruits. Pages 141–187. 30 My 1890.

Vol. 2, No. 1; not furnished separately:

Halsted, Byron David. Reserve food-materials in buds and surrounding parts. Pages 1–26, *plates 1, 2*. 10 S 1890.

Vol. 2, No. 2; price, 75 cents:

Vail, Anna Murray, & Hollick, Charles Arthur. Contributions to the botany of Virginia. Pages 27–56, *plates 3, 4*. 23 D 1890.

Vol. 2, No. 3; not furnished separately:

Holm, Herman Theodor. Contributions to the knowledge of the germination of some North American plants. Pages 57–108, *plates 5–19*. 15 Ap 1891.

Vol. 2, No. 4; price, 75 cents:

Wheelock, William Efner. The genus *Polygala* in North America. Pages 109–152. 30 D 1891.

Vol. 3, No 1; not furnished separately:

Small, John Kunkel, & Heller, Amos Arthur. Flora of western North Carolina and contiguous territory. Pages 1–39. 20 F 1892.

Vol 3, No. 2; price, $2.00:

Morong, Thomas. The *Naiadaceae* of North America [with illustrations of all the species]. Pages 1–65, *plates 20–74*. 15 Mr 1893.

Vol. 3, No. 3; not furnished separately:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. [Part 1.] Pages 1–67. 28 Ap 1893.

Vol. 4, No. 1; not furnished separately:

Underwood, Lucien Marcus. Index *Hepaticarum*. Part I, Bibliography. Pages 1–91. 10 Je 1893.

Vol. 4, No. 2; not furnished separately:

Small, John Kunkel, & Vail, Anna Murray. Report on the botanical exploration of southwestern Virginia during the season of 1892. Pages 93–201, *plates 75–82*. 18 N 1893–17 Ap 1894.

Vol. 4, No. 3; price, 50 cents:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 2. Pages 203–274. 10 Mr–17 Ap 1895.

Vol. 4, No. 4; price, 50 cents:

Pettit, Anna Stockton. *Arachis hypogaea* L. Pages 275–296. *plates 83–85* 5 Je 1895.

Vol. 4, No. 5; price, 75 cents:

Rydberg, Per Axel. The North American species of *Physalis* and related genera. Pages 297–374. 15 S 1896.

Vol. 5; price, $3.00:

List of *Pteridophyta* and *Spermatophyta* growing without cultivation in northeastern North America. Pages 1–377. 4 D 1893–31 D 1894.

Vol. 6, No. 1; price, $1.25:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 3. Pages 1–130. 17 N 1896.

Vol. 6, No. 2; not furnished separately:

Grout, Abel Joel. A revision of the North American *Isotheciaceae* and *Brachythecia*. Pages 131–210. 30 Jl 1897.

Vol. 6, No. 3; price, 50 cents:

Hazen, Tracy Elliot. The life history of *Sphaerella lacustris* (*Haematococcus pluvialis*). Pages 211–246, *plates 86, 87* (*colored*). 8 Je 1899.

Vol. 6, No. 4; price, 50 cents:

Underwood, Lucien Marcus. A review of the genera of ferns proposed prior to 1832. Pages 247–283. 1 D 1899.

Vol. 6, No. 5; price, 25 cents:

Fink, Bruce. Notes on lichen distribution in the upper Mississippi Valley. Pages 285–307. 1 D 1899.

Vol. 7; price, $3.00:

Howe, Marshall Avery. The *Hepaticae* and *Anthocerotes* of California. Pages 1–208, *plates 88–122*. 5 Au 1899.

Vol. 8, No. 1; not furnished separately:

Lloyd, Francis Ernest. The comparative embryology of the *Rubiaceae*. Part I. Pages 1–26, *plates 1–4*. 26 Au 1899. Part II. Pages 27–112, *plates 5–15*. 15 F 1902.

Vol. 8, No. 2; price, $1.00:

Evans, Alexander William. The *Lejeuneae* of the United States and Canada. Pages 113–183, *plates 16–22*. 15 F 1902.

Vol. 8, No. 3; price, 75 cents:

Britton, Elizabeth Gertrude, & Taylor, Alexandrina. The life history of *Vittaria lineata*. Pages 185–211, *plates 23–31*. 30 Au 1902.

Vol. 9; price, $3.00:

Salmon, Ernest Stanley. A monograph of the *Erysiphaceae*. Pages 1–292, *plates 1–9*. 4 O 1900.

Vol. 10; price, $3.00:

Burgess, Edward Sandford. History of Pre-Clusian botany in its relation to *Aster*. Pages i–xii, 1–447. 22 N 1902.

Vol. 11, No. 1; price, $1.75:

Griffiths, David. The North American *Sordariaceae*. Pages 1–134, *plates 1–19*. 30 My 1901.

Vol. 11, No. 2; price, $1.75:

Hazen, Tracy Elliot. The *Ulothricaceae* and *Chaetophoraceae* of the United States. Pages 135–250, *plates 20–42*. 20 O 1902.

Vol. 12, No. 1; price, $1.50:

Northrop, Alice Rich. Flora of New Providence and Andros (Bahama Islands). Pages 1–98, *plates 1–19 + map*. 10 D 1902.

Vol. 12, No. 2; price, $1.00:

Banker, Howard James. A contribution to a revision of the North American *Hydnaceae*. Pages 99–194. 13 Je 1906.

Vol. 12, No. 3; price, 75 cents:

Kupfer, Elsie. Studies in plant regeneration. Pages 195–241. 10 Je 1907.

Vol. 13; price, $3.00:

Burgess, Edward Sandford. Species and variations of Biotian Asters, with discussion of variability in *Aster*. Pages i–xv, 1–419, *plates 1–13*. 15 Mr 1906.

Vol. 14, No. 1; price, $1.25:

Burlingham, Gertrude Simmons. A study of the *Lactariae* of the United States. Pages 1–109, *figures 1–15*. 26 My 1908.

Address: **TORREY BOTANICAL CLUB,**
Columbia University, New York City.

VOL. 35 JULY, 1908 NO. 7

BULLETIN

OF THE

TORREY BOTANICAL CLUB

Editor

MARSHALL AVERY HOWE

Associate Editors

JOHN HENDLEY BARNHART
JEAN BROADHURST
PHILIP DOWELL
ALEXANDER WILLIAM EVANS
TRACY ELLIOT HAZEN
WILLIAM ALPHONSO MURRILL
CHARLES LOUIS POLLARD
HERBERT MAULE RICHARDS

CONTENTS

The development of the sexual organs and sporogonium of Marchantia polymorpha. (Plates 21–25). . . . . ELIAS J. DURAND 321
Studies of West Indian plants — I . . . . NATHANIEL LORD BRITTON 337
Some native weeds and their probable origin. . . . . ROLAND M. HARPER 347
Studies in North American Peronosporales — III. New or noteworthy species. GUY WEST WILSON 361
INDEX TO AMERICAN BOTANICAL LITERATURE. 367

PUBLISHED FOR THE CLUB

THE NEW ERA PRINTING COMPANY
LANCASTER, PA.

THE TORREY BOTANICAL CLUB

President,

HENRY H. RUSBY, M.D.

Vice-Presidents,

EDWARD S BURGESS, PH.D. JOHN HENDLEY BARNHART, A.M., M.D.

Recording Secretary,

C. STUART GAGER, PH.D.

Botanical Garden, Bronx Park, New York City.

Treasurer,

WILLIAM MANSFIELD, PHAR.D.

College of Pharmacy,
115 West 68th St., New York City.

MEETINGS

Meetings twice each month from October to May inclusive: the second Tuesday, at 8:00 P.M., at the American Museum of Natural History; the last Wednesday, at 3:30 P.M., in the Museum Building of the New York Botanical Garden.

PUBLICATIONS

All subscriptions and other business communications relating to the publications of the Club should be addressed to the Treasurer, William Mansfield, College of Pharmacy, 115 West 68th St., New York City.

Bulletin. Monthly, established 1870. Price, $3.00 a year; single numbers 30 cents. Of former volumes, only 24–34 can be supplied separately; certain numbers of other volumes are available, but the entire stock of some numbers has been reserved for the completion of sets. Manuscripts intended for publication in the BULLETIN should be addressed to Marshall A. Howe, Editor, New York Botanical Garden, Bronx Park, New York City.

Torreya. Monthly, established 1901. Price, $1.00 a year. Manuscripts intended for publication in TORREYA should be addressed to Jean Broadhurst, Editor, Teachers College, Columbia University, New York City.

Memoirs. Occasional, established 1889. (See last pages of cover.)

Preliminary Catalogue of Anthophyta and Pteridophyta within 100 miles of New York City, 1888. Price, $1.00.

Vol. 35 No. 7

BULLETIN

OF THE

TORREY BOTANICAL CLUB

JULY, 1908

The development of the sexual organs and sporogonium of Marchantia polymorpha*

ELIAS J. DURAND

(WITH PLATES 21–25)

For some time past the writer has been preparing sets of slides for the use of students in a course in embryology. The aim has been to get together series as complete as possible to illustrate the important steps in the development of at least one representative of each of the great groups of green plants. The slides when finished are numbered, and each valuable section on the slide is marked and numbered. The stages represented are then carefully arranged in sequence and outlines prepared in which they are indicated in their proper order with the numbers of the slides and sections in which they appear. In this way the student, having had all the sections found, marked, and arranged for him, and having to waste no time in searching for the desired stages, can study the maximum amount of material in the minimum of time.

It should be emphasized that such slides are not intended to take the place of but to supplement those which the student makes for himself in order to get training in the methods used in the preparation of such material. It will be readily understood that to get together series of this kind requires much time and patience, but the writer feels that the outlay is fully justified by the results obtained. The student who goes over a set of preparations such as is illustrated in the present paper, making drawings of all the stages, and finally writing up for himself an account of the development of the plant based on his own studies and drawings has at

* Contribution from the Department of Botany, Cornell University, no. 131.
[The BULLETIN for June, 1908 (35 : 283–320. *pl. 18–20*) was issued 1 Jl 1908.]

the end a feeling of satisfaction in having acquired a fairly comprehensive knowledge of the embryology of that species and of the group to which it belongs. Moreover, the preparation of such sets may prove to be of almost as much value to the teacher as to the student.

As the representative of the Marchantiaceae the writer naturally selected *Marchantia polymorpha*, it being the most accessible as well as the most easily studied member of the group. An examination of what has been written concerning this species brought out a rather surprising state of affairs. *Marchantia polymorpha* has long been a favorite object for class study. It has been described and illustrated in practically every textbook treating of the liverworts, and has been made the subject of numerous investigations, so that it would seem as if nothing remained to be done with it. Yet nowhere has there ever been published an even approximately complete account of the development of the antheridia, archegonia, and sporogonia of this species, nor anything approaching a complete series of figures illustrating these phenomena.

Inasmuch as this plant is so commonly used in class work it has seemed to the writer to be desirable that a fairly complete series of illustrations should be available for the use of students. The accompanying figures with the brief account of the development of the sexual organs and sporogonium are therefore presented in the hope that they may be found useful.

Marchantia grows commonly on damp soil in ravines or along wood-roads, but reaches its best development on damp, burnt soil. The writer once visited a burnt-out swamp several acres in extent in which the ground was nearly completely covered with luxuriant thalli to a depth in some places of several inches. The gametophores begin to appear early in May, and the sporogonia mature in July.

ANTHERIDIUM

The antheridia of *Marchantia* are sunk in cavities in the upper surface of the antheridiophore. They develop in acropetal succession, the youngest being near the margin and the oldest near the center of the disk. They do not originate from all portions of the margin equally but the younger ones are produced in certain

definite meristematic regions which lie between the lobes. Goebel regards the antheridiophore as representing an entire branching system, which divides repeatedly, the apices being near the margin and constituting the meristematic regions mentioned. While young antheridia may be found on quite large receptacles, it is best to collect the smaller ones in which the stalk is still very short or even has not begun to elongate. The material from which the present study was made was collected May 26, 1900, and fixed in Flemming's solution. The sections are 8–10 μ thick and stained in Delafield's hematoxylin. This stain is well adapted to work of this kind since it brings out the cell-walls and nuclei very clearly.

The youngest antheridium that I have been able to recognize definitely as such is shown in *figure 1*. It is a conical cell several cells removed from the margin, and has evidently been cut off by a transverse wall from the cell beneath it. A study of the section shows that the neighboring cells also have been derived in the same manner from the cells beneath. An examination of many preparations of young stages has convinced me that the antheridial rudiment of *Marchantia* at no time projects above its fellows later to become buried, but is one of the superficial, dorsal, submarginal cells of the receptacle, having the same origin and being cut off at practically the same time as the cells adjacent to it, but soon becoming separated from them, assuming a conical form, and becoming richer in protoplasmic contents. The one shown in *figure 1* has already been slightly surpassed by the elongating adjacent cells.

In the stage shown in *figures 2* and *3*, the rudiment has been divided by a transverse wall into two cells, the proximal being the mother-cell of the stalk, while the distal is the mother-cell of the antheridium proper. Occasionally the receptacle is so convex above that the young antheridia are nearly horizontal so that transections of the gametophore give longisections of the young organ (*figs. 4–6*).

The young antheridium now enlarges (*figs. 4, 5*) and soon becomes sunk in a cavity owing to the division and upward growth of the surrounding cells (*fig. 6*). The divisions in the lower cell to form the stalk follow no regular order but may be either longi-

tudinal or transverse or both, as may be seen by inspection of *figures 9–24*. In the distal or antheridial cell, however, the divisions are regular. It soon segments transversely into either two (*figs. 7–12*), or three (*figs. 13–20*), or perhaps rarely four cells (*cf. figs. 21, 23*). I have not seen more than two transverse walls in any antheridium at this age, a greater number of walls, so far as my observation goes, always appearing in organs which have progressed considerably in their development, so that they were probably formed subsequently to vertical division (*cf. figs. 24, 25*). Each cell of the antheridium now soon divides by a vertical wall into two. This division usually appears first in the proximal cells (*figs. 10, 14–18*), but occasionally the distal one divides first (*figs. 11, 12*). These vertical walls are then followed by others at right angles to them in each cell so that the young organ consists of two or three tiers of four cells each. In each cell of each tier now appears a periclinal wall separating it into an inner spermatogenous cell and a peripheral wall-cell. This periclinal division begins at the base of the antheridium and progresses toward the apex (*figs. 19–23*), so that the interior spermatogenous cells are finally completely enclosed by the enveloping wall. Further divisions in the latter are entirely radial, so that it remains a single layer of cells in thickness.

The young antheridium now increases rapidly in size. The stalk divides transversely and vertically so that it ultimately consists of 5 or 6 tiers of about four cells each (*figs. 26–29*). The cells of the interior divide transversely (*figs. 24, 25*) and vertically (*figs. 26–29*), so that groups of cuboidal cells result. The original division-walls remain evident even in the mature structure. *Figure 29* represents an antheridium about one fourth to one third grown. The mature organ is similar in form but is much larger and contains a much greater number of cuboidal cells, formed by repeated division of the inner cells. A group of such cells from a fully grown antheridium is shown in *figure 30*. The next division in each cuboidal cell is diagonal, so that two triangular cells or spermatids result (*fig. 31*). According to Ikeno ('03) and Campbell ('05), this final diagonal division is unaccompanied by a wall in *Marchantia* and *Fimbriaria*. My own preparations stained with Delafield's hematoxylin, which brings out cell-walls clearly, shows

diagonal walls very distinctly in some of the cells, but not in all, so that they seem to disappear soon after being formed. The nuclear phenomena accompanying the production of the spermatids and their transformation into spermatozoids, together with the changes in the blepharoplast and the development of the cilia have not been specially studied, since they have been so recently worked out by Ikeno ('03).

The writer has not yet observed the explosive discharge of the spermatozoids, which is so easily seen in *Conocephalum* when the moisture conditions are right. The same phenomenon probably occurs also in *Marchantia*, and one can easily see how it might be useful in effecting fertilization in those archegonia which are matured after the elongation of the stalk of the gametophore.

ARCHEGONIUM

In the vicinity of Ithaca, the young archegoniophores begin to appear early in May. Archegonia mature and fertilization usually takes place by the time the stalk begins to elongate. The necks of such mature organs are strongly curved outward toward the margin of the receptacle. If the first-formed archegonia are fertilized, few are produced subsequently, but if fertilization is not effected they continue to develop in numbers even after the stalk is somewhat elongated. The necks of the later-formed organs are nearly straight. *Figures 32* to *69* were made from material collected when the stalks of the archegoniophores had just begun to elongate, and when mature antheridia were present on adjacent plants. It was gathered May 9, 1907, and fixed in Gilson's solution. The sections are 8–10 μ thick and stained in Delafield's hematoxylin.

The archegonia arise in radiating rows from the tissue between the lobes on the underside of the gametophore. The youngest are nearest the stalk and the oldest near the margin. The development accords in general with that usual in the Marchantiales, but since it differs in some particulars it seems best to give a brief account of the whole process. A superficial cell pushes outward beyond its fellows and its distal part is cut off by a transverse wall. The hemispherical cell thus formed is the mother-cell of the archegonium (*figs. 32, 33, 40*), and may be recognized by its deeply

staining contents. I cannot confirm the statement of Strasburger ('69) that this mother-cell is divided into two by a transverse wall, but the first division-wall is obliquely vertical and curved, and divides the mother-cell into two unequal cells (*figs. 34, 35, 63*). The second wall is in the larger cell, and is likewise obliquely vertical and curved (*figs. 36, 37*), cutting both the first division-wall and the wall of the mother-cell (*fig. 38*). A third similar wall cuts both the first and second (*cf. fig. 46*). The young archegonium has thus been segmented into an axial cell, triangular in transection, bounded by three peripheral ones. The axial cell is next divided by a transverse wall into a distal cover-cell and a proximal mother-cell of the axial row (*figs. 39, 40*). The cover-cell may segment at once (*fig. 41*), but more often it remains entire for some time (*cf. figs. 42–65*). Ultimately it becomes divided into four by two walls at right angles to each other (*figs. 47, 67, 57, et seq.*). Each of the three peripheral cells next divides by a transverse wall near the middle (*figs. 42, 43*), and these are soon followed by a corresponding one in the axial cell dividing it into a proximal central cell and a distal neck-canal mother-cell (*figs. 44, 45*). These last divisions have separated the young archegonium into two regions: the neck and the venter. About the same time each of the three peripheral wall-cells divides radially so that the wall consists of six rows of cells (*fig. 46*). Although the wall of the venter undergoes further radial division (*fig. 59*), six remains the constant number in the neck (*figs. 60, 66*).

Meanwhile the cell or cells immediately beneath the archegonium, from which the mother-cell was originally derived, grow outward (*figs. 37, 39, 40*), and divide transversely, forming what at first appears to be a stalk of the archegonium (*figs. 43–45*), but what really becomes the proximal cells of the wall of the venter (*cf. figs. 48–65*). In the young archegonium shown in *figure 34* this has taken place unusually early. It will thus be seen that the archegonium is not entirely derived from the original hemispherical mother-cell.

The young archegonium now undergoes a period of growth. The axial cells elongate, the central cell becoming the larger with a conspicuous nucleus. The wall-cells undergo repeated trans-

verse division, and those of the venter radial division also (*figs. 48–54*). The neck-canal mother-cell now divides transversely into two (*figs. 55, 56*), and then each of these into two, making four neck-canal-cells (*fig. 58*). The central cell then divides unequally into a distal ventral canal-cell and the larger egg. The writer does not think that a definite cell-wall is laid down in this last division. If it is, it disappears very soon, for the two cells are separated by a space in almost every instance (*fig. 61*). As a rule the central cell does not divide until after the four neck-canal-cells have been formed, but quite a number of instances were noted in which it had segmented when only two canal-cells were present (*fig. 57*).

All the parts of the archegonium having been differentiated, further development is in the nature of expansion or enlargement of the parts already formed. Up to this time the organ has been nearly cylindrical, but after the division of the central cell the venter becomes somewhat swollen or thickened owing to the enlargement of the egg within (*figs. 62–65, 68, 69*). The cytoplasm stains very intensely and the nucleus is large and conspicuous. The neck elongates by repeated transverse division of the wall-cells, and sometimes becomes very long and curved. The neck-canal-cells elongate and the separating walls soon disappear (*figs. 65, 68*). While four is the usual number of cells, their nuclei occasionally divide so that six or seven sometimes appear (*figs. 65, 68*). In one case (*fig. 68*) the cytoplasm of one of the cells had segmented so that five distinct masses were present. As the archegonium approaches maturity, the ventral canal-cell and the neck-canal-cells become disorganized and coalesce into a slender mucilaginous strand in the cavity of the neck. Soon the cover-cells break apart and the mass exudes, leaving an open channel to the egg (*fig. 69*). The latter becomes nearly spherical and stains very deeply. No indication of a "receptive spot" was observed.

EMBRYO AND SPOROGONIUM

The sporogonia of *Marchantia* develop rapidly. Archegonia are ready for fertilization in May and fully mature sporogonia may be found in the latter part of June or in July. Part of the material collected for archegonia May 9, 1907, was kept in the laboratory

under a bell-jar for five days, when it was fixed in chrome-acetic solution. *Figures 70–90* were made from this collection. *Figures 91–101* are from plants killed in Flemming's solution June 9, 1900. The sections are 8–10–12 μ thick and stained in Delafield's hematoxylin.

The unfertilized egg of *Marchantia* is nearly spherical in form, and is stained intensely by Delafield's hematoxylin. After fertilization it elongates slightly, becomes surrounded by a wall, and is stained with difficulty and diffusely with the same reagent (*figs. 70, 71*). This difference in staining capacity is marked and continues until the embryo has become many-celled (*fig. 93*). Another conspicuous reaction to stain is shown by the inner surface of the wall of the archegonium, which becomes deeply colored, so that in sections the pale embryo stands out in bold relief against the dark background (*figs. 70, 76, 81, 82, et al.*) The first division-wall in the fertilized egg is obliquely transverse. *Figures 72–76* show longitudinal sections of five embryos at this stage. These and the subsequent figures have been arranged so that the axes of the archegonia are parallel. In *figure 75* the wall is transverse, while extremes of obliquity are shown in more advanced embryos in *figures 77* and *84*. The second wall is perpendicular to the first, dividing the embryo into quadrants (*figs. 77–81*). The third (*fig. 82*), at right angles to the first and second, divides it into octants.

The next divisions are anticlinal (*figs. 83–90*), and are placed at such a peculiar angle with the second and third walls that essentially similar patterns are presented in both longitudinal and transverse sections. This is made evident by comparing *figures 80–88* with *89* and *90*. As a rule anticlinal division has not proceeded far before periclinal walls begin to be laid down (*figs. 83, 85–87*). Further divisions are anticlinal, periclinal, and radial, without definite sequence, until a subspherical ball of cells is produced (*figs. 91–93*), in which the primary division-walls may usually be clearly recognized. Up to this time the embryo has increased but little in size, so that its component cells become successively smaller as division progresses (*cf. figs. 70–93*).

While the above-mentioned development is proceeding in the embryo, other and more conspicuous changes are taking place in the venter of the archegonium and in the tissue at its base. In

the first place the collar at the base of the archegonium, which is inconspicuous before fertilization (*figs. 63, 69*), by transverse division of its cells grows rapidly outward until it forms a tubular sheath, the pseudoperianth, surrounding the venter, and ultimately projecting far beyond it. This is always a single layer in thickness (*figs. 70, 76, 88, 92, 94*). In the second place, periclinal division begins in the wall of the venter, and continues until two or three layers of cells are formed at the sides of and above the embryo. The tissue thus formed is the calyptra, which serves as a protective covering for the growing embryo (*figs. 70, 71, 76, 81, 82, 88–90, 92, 94–98*). The contents of its cells soon become richer so that it is stained more deeply.

The third series of changes is in the base of the venter and in the cells immediately beneath it, from which the pseudoperianth arises (*fig. 70*). Division takes place in all directions so that the base, originally narrow and rarely more than three cells across, becomes broad and massive (*figs. 70, 76, 88, 92, 94*). The cells thus formed from the base of the archegonium are generally smaller than those of the adjacent gametophore (*fig. 94*), and soon become rich in protoplasmic content and stain deeply.

The embryo and surrounding tissues now enlarge rapidly and the contents of all the cells increase in staining capacity (*fig. 94*). This is especially noticeable in the tissue beneath the embryo, derived from the base of the archegonium. The embryo itself becomes nearly spherical (*figs. 94–97*), and then broader than long (*figs. 98, 99*). The first indication of its differentiation into parts is a change in the staining capacity of the cells. Those in the distal half become richer in protoplasmic content, and form the capsule, while those of the proximal half stain with less avidity, and give rise to the stalk and foot (*figs. 95, 96*). An inspection of the embryo shown in *figure 95* shows that the stalk and capsular halves are separated by the first transverse division-wall, and this is usually the case. That it is not always true, however, is shown in *figure 96*. In this embryo the original walls were decidedly oblique, as in *figures 77* and *84*. In such cases the first division-wall does not separate the embryo into the stalk and capsular halves, but this differentiation is determined by other influences. In general it is true that, whatever be the direction of the

first division-wall, the proximal cells constituting about one half of the embryo give rise to the stalk and foot, while those of the distal half become the capsule. The line of demarcation between them is not always clear-cut, and generally coincides very nearly with the first transverse wall; but often it does not so coincide, and certainly does not necessarily do so.

As the young sporogonium enlarges, the superficial cells of the capsular portion stain less deeply and become sharply set off as an outer sterile wall of a single layer of cells enclosing the deeply staining sporogenous tissue within (*fig. 97*). The cells of the latter at this time are irregularly isodiametric, and similar to those of the stalk half. In the sporogonium figured one can detect a slight bulging of the proximal tissue of the stalk to form the beginning of the foot.

A more advanced and very interesting stage is shown in *figure 98*. The whole structure has become broader; the wall is sharply differentiated from the sporogenous tissue within; the cells of the latter have increased in number, and most of them have elongated somewhat in a direction parallel to the axis of the archegonium; the proximal cells of the stalk have become richer in contents, and are closely applied to the tissue at the base of the archegonium, into which they have begun to penetrate to form the foot. It should be noted that the cells of the archegonium adjacent to the foot are not crushed out nor flattened, but are plump and the contents stain deeply.

A still more advanced condition is shown in *figure 99*. The foot has penetrated more deeply into the basal cells of the archegonium, and has expanded laterally, forming a "pileus-shaped" absorbent organ, the cells of which are filled with deeply staining food material in the form of elliptical bodies. The capsular portion is broad, the sporogenous cells numerous and plainly elongated. In neither of the sporogonia shown in *figures 98* and *99* is the line of demarcation between the stalk and sporogenous tissue regular, so that it probably does not exactly conform to the original transverse wall of the embryo.

In the still older sporogonium shown in *figure 100*, the foot has become more massive and has penetrated more deeply into the tissue of the base of the archegonium. The cells of the sporog-

enous tissue have separated completely from one another, and have elongated. The great majority are narrowly triangular in outline, and are frequently arranged in pairs end to end. A few, however, are narrow and slender, and present the first indications of a differentiation between sporogenous cells and elaters. In the much larger embryo shown in *figure 101*, the distinction between fertile cells and elaters is more marked. The former have lost to some extent the regular triangular outline, while the latter are much more slender and sometimes flexuous. The two kinds of cells alternate irregularly.

In its further development the sporogonium elongates rapidly until it becomes oblong or elliptical in general outline. The stalk, however, remains for a long time very slight. At the same time the separate cells filling the capsule increase in size. The elaters become long and fusiform, and the contents arranged in a spiral manner next the wall. While the sporogenous cells increase in size they do not seem to increase in number after the separation shown in *figure 100*. They soon divide, however, by transverse, or by transverse and longitudinal walls into groups of eight, rarely four, cells (*fig. 102 a–h*), which do not separate but remain connected together. These are the spore-mother-cells. If the division is transverse only, the mother-cells are arranged in rows (*fig. 102 a, d, e*). If longitudinal division also occurs, the mother-cells are biseriate or subbiseriate in the group (*b, c, f, g, h*). A very characteristic condition is shown in figures *c* and *h*, in which the original cells were subtriangular in outline and arranged in pairs, as appears so often in *figures 100* and *101*. The resulting groups of mother-cells are also subtriangular in form and still remain in pairs. The mother-cells are irregular in shape, and are flattened where contiguous ones come in contact.

The mother-cells now increase in size as the capsule expands. The details of their division have not yet been worked out, but each gives rise to four tetrahedral spores (*fig. 103 i–m*). The spores remain connected in the tetrads for a long time, and the latter, as well, cling together nearly as long in their original groups. The tetrads, however, seem to become free from one another before the spores separate (*fig. 103 m*).

About the time of the division of the spore-mother-cells, ac-

tivity begins in the stalk. Each component cell divides repeatedly in a direction transverse to the long axis of the sporogonium, so that very regular rows of cells are produced between the foot and the capsule. The latter is thus pushed outward until the calyptra is ruptured at its apex. At first the cells of the stalk are broader than long, but later they increase greatly in length so that the stalk elongates, pushing the capsule beyond the surrounding perianth. As the capsule dries it ruptures at the apex into numerous lobes so that the spores and elaters are set free.

BIBLIOGRAPHY

Only the principal original literature dealing with embryology of *Marchantia polymorpha* is here included.

Bischoff, G. W. Bemerkungen über die Lebermoose, vorzüglich aus den Gruppen der Marchantieen und Riccieen. Nova Acta Acad. Leop.-Car. **17**: 911–1088. *pl. 67–71*. 1835.

Goebel, K. Outlines of classification and special morphology. Oxford. 1887.

Henfrey, A. On the development of the spores and elaters of *Marchantia polymorpha*. Trans. Linn. Soc. **21**: 103–110. *pl. 11*. 1853.

Hofmeister, W. On the germination, development, and fructification of the higher Cryptogamia and on the fructification of the Coniferae. London. 1862. [Trans.]

Ikeno, S. Die Spermatogenese von *Marchantia polymorpha*. Beih. Bot. Centralb. **15**: 65–88. 1903.

Kienitz-Gerloff, F. Vergleichende Untersuchungen über die Entwickelungsgeschichte des Lebermoos-Sporogoniums. Bot. Zeit. **32**: 161–172. *pl. 3*. 1874.

Kny, L. Bau und Entwickelung von *Marchantia polymorpha*. Sonderabd. a. d. Text d. VIII Abt. d. Bot. Wandtaf. 1890.

Leitgeb, H. Untersuchungen über die Lebermoose. VI. Die Marchantieen. 1881.

Mirbel, M. Recherches anatomiques et physiologiques sur le *Marchantia polymorpha*. Mém. Acad. Roy. Sc. Inst. France **13**: 337–436. *pl. 1–10*. 1835.

Strasburger, E. Die Geschlechtsorgane und die Befruchtung bei *Marchantia polymorpha* L. Jahrb. Wiss. Bot. **7**: 409–422. *pl. 27, 28*. 1869.

DEPARTMENT OF BOTANY,
CORNELL UNIVERSITY, ITHACA, NEW YORK.

Explanation of figures (plates 21-25)

All figures were drawn with the aid of the camera lucida. Figures 1–30, 32–69, 102, and 103, were drawn with the B. & L. one-eighth objective and one-inch ocular. Figure 31 was drawn with the one-twelfth objective and one-inch ocular. Figures 70–101 were drawn with the one-sixth objective and one-inch ocular. The exact magnification is indicated with each plate.

ANTHERIDIUM

FIG. 1. Longitudinal section of gametophore showing 1-celled rudiment of the antheridium.

FIGS. 2, 3. The antheridial rudiment has divided by a transverse wall into the mother-cell of the stalk and mother-cell of the antheridium proper.

FIGS. 4, 5. Same as last but from transverse section of the gametophore; antheridium enlarging.

FIG. 6. Same as last but young antheridium becoming more deeply buried by the upgrowth of the surrounding cells.

FIGS. 7, 8. The whole organ more deeply buried; antheridial mother-cell divided by a transverse wall.

FIG. 9. As in last but division beginning in mother-cell of the stalk.

FIGS. 10–12. As in last but vertical division beginning in mother-cell of antheridium proper.

FIG. 13. Antheridial mother-cell divided by two transverse walls.

FIGS. 14–18. As in last but showing variations in division in the stalk, and successive steps in vertical division of antheridium.

FIGS. 19–23. Steps in the periclinal division of the antheridium to separate the wall from the spermatogenous tissue within.

FIGS. 24, 25. Antheridium enlarging; beginning radial division in the wall, and transverse division of spermatogenous tissue.

FIGS. 26–28. Further radial division in the wall; successive steps in division of spermatogenous tissue by transverse and vertical walls into cuboidal cells; increasing massiveness of the stalk.

FIG. 29. Antheridium one fourth to one third grown; original vertical and transverse walls plainly evident.

FIG. 30. A block of cuboidal cells from a mature antheridium just before their diagonal division to form the spermatids.

FIG. 31. A block of cuboidal cells from same antheridium as figure 30, showing diagonal division to form the spermatids. Note that in some of the cells diagonal walls appear between the spermatids. One-twelfth objective.

ARCHEGONIUM

FIGS. 32, 33, 40. Mother-cell of the archegonium cut off from the cell of the gametophore from which it has arisen.

FIGS. 34, 35. The mother-cell divided by one obliquely vertical wall.

FIGS. 36, 37. The mother-cell divided by two obliquely vertical walls.

FIG. 38. Transection of young archegonium, showing relation of the two walls.

FIGS. 39, 40. The axial cell divided by a transverse wall to form the cover- and the mother-cell of the axial row.

FIG. 41. Cover-cell divided.

FIG. 42. One peripheral cell divided transversely.

FIG. 43. All peripherals divided transversely.

FIGS. 44, 45. Peripherals and mother-cell of axial row divided transversely, the latter into the central cell and mother-cell of the neck-canal-cells. The young archegonium is now differentiated into the neck and venter.

FIG. 46. Transection of venter at this stage.

FIG. 47. Transection of cover of same archegonium as in figure 46.

FIGS. 48–54. Steps in the radial division of the wall and increase in length of the archegonium.

FIGS. 55, 56. The neck-canal mother-cell has divided transversely into two.

FIG. 57. An abnormal condition in which the ventral canal-cell has been cut off before the formation of four neck-canal-cells.

FIG. 58. Four neck-canal-cells, central cell undivided.

FIG. 59. Transection of venter of about the stage of figure 58.

FIG. 60. Transection of neck of same archegonium.

FIG. 61. Central cell divided into the egg and ventral canal-cell.

FIGS. 62–64. Archegonium enlarging; four neck-canal-cells.

FIG. 65. Nuclei of two of the neck-canal-cells divided.

FIG. 66. Transection of neck of about the stage of figure 65.

FIG. 67. Transection of cover-cells of same archegonium as in figure 66.

FIG. 68. Archegonium mature; canal-cells ready to disintegrate; five neck-canal-cells with seven nuclei.

FIG. 69. Base of archegonium, egg ready for fertilization.

SPOROGONIUM

FIG. 70. Base of an archegonium containing a fertilized but undivided egg. Note the beginning pseudoperianth.

FIG. 71. Transection of similar stage.

FIGS. 72–76. Fertilized egg once divided. In 76 note the growth of the pseudoperianth and increasing tissue at base of archegonium.

FIGS. 77–80. Embryo divided into quadrants.

FIG. 81. Transection of quadrant stage.

FIG. 82. Transection of octant stage. In 81 and 82 note the periclinal division in the wall of the venter.

FIGS. 83–88. Steps showing formation of anticlinal walls in each octant. Figures 83, 85–87, show also the beginning of periclinal walls. In 88 note the increasing pseudoperianth and tissue at base of the archegonium.

FIGS. 89, 90. Transections of similar stages.

FIGS. 91–93. Older embryos. Note the slight increase in size over 70.

FIG. 94. Embryo increasing in size. Note the massive base of the archegonium and the pseudoperianth.

FIG. 95. An older stage. Note that the distal half stains more deeply, the two halves being separated by the original transverse wall.

FIG. 96. Similar to last but the distal deeply staining portion is not separated from the proximal paler part by the original transverse wall.

FIG. 97. An older larger stage in which the distal half of the embryo is differentiated into an outer wall of one layer of cells enclosing the deeply staining sporogenous tissue within, and the basal portion of the proximal half has begun to grow toward the tissue at the base of the archegonium to form the foot.

FIG. 98. The deeply staining foot has begun to penetrate the base of the archegonium, and the cells of the sporogenous tissue have begun to elongate somewhat.

FIG. 99. Sporogenous cells about as in figure 98, but the foot has pressed into the base of the archegonium and expanded to form a pileus-shaped absorbent organ, which is filled with food material.

FIG. 100. A more advanced stage in which the sporogenous cells have separated from one another and become long-triangular in shape and often arranged in pairs.

FIG. 101. Somewhat older than the last. The sporogenous cells have become differentiated into two kinds: stout ones and more slender elaters.

FIG. 102. The stout cells of the last figure have become divided into 8 (rarely 4) spore-mother-cells, those of each group being arranged either in single rows (*a*, *d*, *e*) or in a triangular or subbiseriate manner (*b*, *c*, *f*, *g*, *h*). The groups are frequently arranged in pairs (*b*, *c*, *h*) corresponding to the paired cells of figures 100 and 101.

FIG. 103. An older stage in which each spore-mother-cell has divided into four spores, the tetrads still clinging together in groups of 4 or 8. In *m*, the oldest stage, they have begun to separate but still form an easily recognized group.

Studies of West Indian plants — I

Nathaniel Lord Britton

1. THE JAMAICAN SPECIES OF HERNANDIA

On March 20, 1908, while exploring a wooded hill near Dolphin Head Mountain, parish of Hanover, in the western part of Jamaica, in company with Mr. William Harris, we observed large trees which were unknown to us from the character of their trunks, and too high to enable us to determine the character of their foliage without a pair of field glasses, which we did not have along that day. While sitting at lunch in a relatively open place in the forest, we observed the top of one of these trees, some 30 meters high and at least a meter in diameter, against the sky line, and saw that it was covered with round fruits, some of which we found on the ground under this tree, and realized that we had found a very interesting species. Our negro guide felled a somewhat smaller tree with his machete, and thus enabled us to obtain excellent fruiting herbarium and museum specimens of the Jamaican species of *Hernandia*.

Up to this time the tree does not appear to have been definitely known to botanists in the island of Jamaica. Patrick Browne (Civil and Natural History of Jamaica, 373, 1756), admits the genus and remarks: "This tree is pretty common in Barbadoes and Mountserat, and grows to a considerable size in those islands; but I have not seen any in Jamaica, though I have been credibly informed that it was frequent in the parish of Portland. The cups that sustain and partly invelop the nuts are very large, and, as they move in the wind, keep a whistling noise, which is often frightful to unwary travellers. The seeds are very oily." Browne cites Jack-in-a-Box as a common name.

In Flora of the British West Indian Islands, page 285, published in 1860, Grisebach does not attribute the tree to Jamaica at all, thus indicating that no specimens of it were extant at that time, but Meissner, in DeCandolle's Prodromus (**15**[1] : 263. 1864),

does credit it to Jamaica, and cites P. Browne, although, as he omits an exclamation mark, it is evident that he did not see a specimen, nor does his herbarium, now at the New York Botanical Garden, contain any *Hernandia* from Jamaica; Meissner refers the record of P. Browne to the species *Hernandia sonora* L., native of the Windward Islands and Porto Rico, and perhaps also of the East Indies.

Hernandia sonora is readily distinguishable from the other species by its peltate, long-pointed leaves, and the only other West Indian species known is the Cuban *Hernandia cubensis* Griseb., which has narrow long-acuminate leaves. Under *H. sonora*, Meissner (DC. Prodr. 264) notes a variety *guadeloupensis* from Guadeloupe Island, which has leaves rounded at the apex and base, or slightly cordate. It is possible but not probable that this is the same as the Jamaican tree, but the description is insufficient to make this certain. In any event, the Jamaican tree is evidently specifically distinct from either *H. sonora*, or *H. cubensis*. There is a species of *Hernandia*, *H. guianensis*, in French Guiana, but not much is known of it other than the plate of Aublet, Pl. Guian. *pl. 329*, which shows that this must be quite different from the plant here to be described.

Hernandia jamaicensis Britton & Harris

A tree 30 m. high or less, with spreading and ascending stout branches, the trunk becoming at least a meter in diameter, the young twigs more or less flattened and angled. Leaves subcoriaceous, sometimes 2.5 dm. long; petioles stout, somewhat shorter than the blade, but sometimes 1 dm. in length, the blades elliptic to elliptic-obovate, obtuse at the apex, obtuse or subcuneate at the base, 3-nerved or faintly 5-nerved, not at all peltate; inflorescence as long as the leaves or longer, racemose or racemose-paniculate; calyx of the pistillate flowers turbinate, about 5 mm. long, its margin truncate; fruiting calyx subglobose, yellow, fleshy, 3–4 cm. long and about as thick as long, its wall about 1 mm. thick, its orifice 1.5–2 cm. wide with a slightly raised margin; drupe ovoid, nearly 2 cm. long, 1.5 cm. in diameter, rounded at the base, bluntly pointed, bluntly 8-ribbed and rugose between the ribs.

On wooded hill, at about 400 meters altitude, near Dolphin Head, Jamaica (*Britton 2321*, type; *Harris 10312*); Woodstock, Westmoreland, Jamaica (*Harris 9835*).

2. THE GENUS CASSIPOUREA IN JAMAICA

Cassipourea was proposed by Aublet (Hist. Pl. Guian. 1: 528) in 1775 for a tree of French Guiana, his *Cassipourea guianensis* being the type of the genus. Swartz (Prodr. 84) published the generic name *Legnotis*, including in it two species, *L. elliptica* from Jamaica and *L. Cassipourea*, based on Aublet's *Cassipourea guianensis*; he assigns no reason why his name thus published in 1788 should replace Aublet's *Cassipourea* of 1775. Poiret (Lam. Encycl. Suppl. 2: 131) properly adopted the older generic name and transferred the *Legnotis elliptica* of Swartz to it. A number of additional species from tropical America and Africa have since been added by several authors, including *Cassipourea alba* Griseb. from the island of Dominica. That *Cassipourea* Aublet and *Legnotis* Swartz are the same genus seems evident from an examination of specimens.

Cassipourea elliptica (Sw.) Poir. is a shrub or small tree, sometimes reaching 6 meters in height, and grows in Jamaica on rocky wooded hillsides. Its elliptic long-pointed leaves are as brilliantly shining as those of any plant known to me, and individuals seen in contrast to the duller luster of other trees and shrubs stand out as most striking elements in the landscape. Mr. Harris, Dr. Hollick, and I, while botanizing near Kempshot, at an altitude of about 500 meters in the parish of St. James, western Jamaica, on March 23, 1908, had our first opportunity of studying this wonderfully beautiful plant in the field, and were fortunate enough to see its bright white flowers with strikingly laciniate petals, and it was an experience long to be remembered. The lustrous leaves and pediceled flowers distinguish *Cassipourea elliptica* from the two species to be described below. A remarkable feature of an individual tree found by us near Kempshot on March 24, 1908, is the development of the lower branches, which droop and bear leaves not more than one half the size of those on the flowering branches above, the twigs of these drooping branches being very slender and repeatedly forked. We preserved herbarium specimens of this curious bud-sport; if cuttings from such a branch could be propagated, they would doubtless yield a weeping *Cassipourea*.

The distinguishing characters of the three Jamaica species are indicated by the following key:

Pedicels as long as the calyx or longer; leaves brilliantly shining. 1. *C. elliptica.*
Pedicels much shorter than the calyx, or scarcely at all developed; leaves dull or faintly shining.
Leaves elliptic-lanceolate, narrowed at the base, the petioles about as long as the calyx. 2. *C. subsessilis.*
Leaves ovate, subcordate at the base, petioles only half as long as the calyx. 3. *C. subcordata.*

1. CASSIPOUREA ELLIPTICA (Sw.) Poiret

On rocky wooded hills, Kempshot and vicinity (*Britton 2397* and *2423; Harris 10330, 10340*); collected also in Jamaica by Swartz and by Purdie.

2. **Cassipourea subsessilis** sp. nov.

A tree about 6 m. high with slender spreading branches. Leaves elliptic-lanceolate, 6–9 cm. long, 3.5 cm. wide or less, acuminate at the apex, narrowed at the base, entire-margined, dull green on both sides, or faintly shining above, the midvein prominent beneath, the petioles 4–7 mm. long; flowers solitary in the axils, nearly or quite sessile; calyx campanulate, its tube 3 mm. long, its lobes ovate to ovate-lanceolate, about as long as the tube; ovary appressed-pubescent; capsule subfusiform, appressed-pubescent, about 1.3 mm. long, 2.5 mm. in diameter, surmounted by the persistent appressed-pubescent style.

On wooded hill near Dolphin Head, parish of Hanover, Jamaica, at about 400 meters altitude (*Britton 2316; Harris 10307*).

3. **Cassipourea subcordata** sp. nov.

A tree 4 m. high, the twigs rather stout, the branches ascending. Leaves ovate, bright green on both sides but not strongly shining, 5–7 cm. long, 3.5 cm. wide or less, short-acuminate at the apex, subcordate at the base, the midvein prominent beneath, the petioles rather stout, 2–3 mm. long; flowers 1 or 2 together in the axils, very nearly sessile; calyx tube obconic, 2.5 mm. long, the lobes ovate, obtusish, about as long as the tube, petals white, fimbriate.

Along a brook, Troy, Jamaica (*Britton 488*, type); collected also by Mr. Harris at the same place (*no. 9466*).

3. THE GENUS TEREBINTHUS P. BR. IN THE WEST INDIES

The type species of *Terebinthus* P. Br. is *Pistacia Simaruba* L., commonly known as the West Indian birch. A subsequent name for the genus is *Bursera* Jacq. but, as shown by Dr. J. N. Rose (Contr. U. S. Nat. Herb. **10**: 118), this name is unavailable, because *Terebinthus* has priority. Seven species are known to me from the West Indies, two of them here to be described as new; the Mexican species have been listed by Dr. Rose.

Leaflets broad, ovate, elliptic, or obovate.
  Leaflets 3–11, ovate, acuminate or acute.
    Leaflets thin; bark exfoliating in thin layers. 1. *T. Simaruba.*
    Leaflets coriaceous; bark close. 2. *T. Hollickii.*
  Leaflets only 1, obovate to elliptic, obtuse. 3. *T. simplicifolia.*
Leaflets narrow, oblong to lanceolate or oblanceolate.
  Leaflets obtuse at the base. 4. *T. glauca.*
  Leaflets acute at the base.
    Inflorescence elongated, sometimes as long as the leaves.
      Leaflets 5–11, linear-oblong to linear-lanceolate. 5. *T. angustata.*
      Leaflets 3–5, oblong to oblanceolate. 6. *T. inaguensis.*
    Inflorescence short, compact, in fruit not longer than the petioles; leaflets 1–3. 7. *T. Nashii.*

1. TEREBINTHUS SIMARUBA (L.) W. F. Wight, Contr. U. S. Nat. Herb. **10**: 122. 1906.

Pistacia Simaruba L. Sp. Pl. 1026. 1753.
Bursera gummifera L. Sp. Pl. ed. 2, 471. 1762.
Bursera gummifera glabra Griseb. Fl. Br. W. I. 173. 1859.
Bursera gummifera pubescens Engler, in DC. Mon. Phan. **4**: 40. 1883.

Florida; Bahamas; Cuba; Jamaica; Haiti; Porto Rico; St. Thomas to Grenada; Mexico to Colombia and Venezuela.

Most of the Jamaica trees have pubescent twigs and leaf-rachises; this hairy race is evidently the typical one, based by Linnaeus on Sloane, *pl. 199*.

2. **Terebinthus Hollickii** sp. nov

A tree 6 m. high, with trunk 2.5 dm. in diameter, its bark about 8 mm. thick, reddish-gray outside, red inside, close, not peeling off in papery layers. Young twigs stout, pubescent; leaves 8–12

cm. long, clustered at the ends of the twigs; rachis pubescent with spreading hairs; leaflets 3–7, coriaceous, ovate 3–6 cm. long, 1.5–3 cm. wide, entire-margined, obliquely rounded at the base, short-acuminate at the apex, glabrous or very nearly so when old, very inconspicuously veined above, rather prominently veined beneath; petiolules stout, 3–5 mm. long; fruiting inflorescence 4–7 cm. long, the raceme simple or slightly compound, its axis pubescent; fruits 8–10 mm. long, about 7 mm. thick, bluntly triangular, on stout pedicels 4 or 5 mm. long; seed sharply 3-angled.

Dry rocky hillside, Fort Henderson, Kingston Harbor, Jamaica (*N. L. Britton & Arthur Hollick*, March 2, 1908, *no. 1816*).

3. **Terebinthus simplicifolia** (DC.)

Bursera simplicifolia DC. Prodr. **2**: 78. 1825.

Frequent on dry hillsides near the southern coast of Jamaica, becoming at least 13 meters high.

4. **Terebinthus glauca** (Griseb.)

Bursera glauca Griseb. Cat. Pl. Cuba 66. 1866.

Cuba.

5. **Terebinthus angustata** (Griseb.)

Bursera angustata Griseb. Cat. Pl. Cuba 65. 1866.

Cuba.

6. **Terebinthus inaguensis** (Britton)

Bursera inaguensis Britton, Bull. N. Y. Bot. Gard. **3**: 443. 1905.

Bahama Islands, from Eleuthera and Great Guana Cay to Inagua.

Combs 454, from Calicita, Santa Clara Province, Cuba, resembles this very closely, more closely than it does *T. angustata*.

7. **Terebinthus Nashii** sp. nov.

A tree about 3 m. high with nearly smooth terete twigs, glabrous throughout. Leaves 1–3-foliolate, the slender petiole 5–15 mm. long, somewhat glaucous; leaflets linear-oblong, narrowed at the base, obtuse or acutish and mucronulate at the apex, 3–5 cm. long, 1–1.5 cm. wide, pale green, very indistinctly veined on both sides, chartaceous; fruiting inflorescence short, few-fruited, 2 cm. long or less; fruits 6–7 mm. long, nearly as thick as long, borne on short stalks, 2–5 mm. long, the calyx persistent at their bases.

Gonaives to La Hotte Rochée on road to Terre Neuve (*Geo. V. Nash & Norman Taylor*, August 12, 1905, *no. 1559*).

4. PASSIFLORA CILIATA Ait.

This species was described in 1789 (Hort. Kew. 1 : 310) from plants cultivated by Mrs. Norman, who introduced it into England from Jamaica in that year. In the Botanical Magazine, plate 288, published January 1st, 1795, Curtis remarks that he saw it during the latter part of the preceding summer with great profusion of flowers in several collections, and the figure given by him at this place was made from a plant in the collection of Mr. Vere.

This beautiful passion-flower seems to have been much misunderstood by subsequent botanists. It appears to be confined naturally to the island of Jamaica, where Mrs. Britton found it in March, 1908, in quantities along roadsides through the hills near Bulstrode, parish of Westmoreland, growing with *P. foetida.*

The plant has been supposed to be a variety of *P. foetida*, and has been so ranked by a number of authors. Grisebach, in Flora of the British West Indies, however, regarded it as specifically distinct, but apparently erred in attributing it to the Bahamas as well as to Jamaica. It has not been found in the Bahamas during any of our extensive explorations of that archipelago. So far as one can see, Grisebach was quite justified in maintaining it as a species distinct from *P. foetida.*

5. BIDENS PILOSA L.

This species was founded by Linnaeus (Sp. Pl. 832) in 1753 on the "*Bidens latifolia* hirsutior semine angustiore radiato" of Dillenius Hort. Eltham. 51. *pl. 43. f. 51.* The name has since been used by many authors for a very common and well-known tropical weed and often with the remark that it is not pilose. Dr. Gray surmised that the figure of Dillenius might really have been made from a plant of *B. frondosa.* During repeated trips to the West Indies I have looked closely at a great many individuals of this weedy plant but never could find any pilose ones until this spring; the species is usually almost or quite without trichomes. But at Moneague, Parish of St. Ann's, Jamaica, in April, 1908, I noticed

with great interest a roadside ditch full of these plants, some densely pilose all over, some essentially glabrous. I could not see at the time of collecting nor have I been able to see from further study of the dried specimens, any other difference whatever in the two races. Both are rayless, have identical achenes varying from 2 to 4, with awns relatively of the same length, leaves of the same shape and texture and involucral scales alike From the environment and occurrence there was nothing to prevent one coming from the seeds of the other. The plants as here observed are not as stout nor as large-leaved as the figure of Dillenius. The typical race of *Bidens pilosa* L. is then well named, but it is apparently rare.

Bidens leucantha (L.) Willd. published by Linnaeus as *Coreopsis leucantha* (Sp. Pl. ed. 2. 1282), also a very common tropical weed, has sometimes been regarded as a variety of *B. pilosa*. It has white rays often 1.5 cm. long, and in life appears very different, but herbarium specimens from which the rays have fallen are often difficult to place. It commonly grows with the glabrous *B. pilosa*, but perhaps more frequently in separate patches and in the West Indies one frequently sees large areas inhabited by the one to the exclusion of the other. At Kempshot, near Montego Bay, Jamaica, they grew together in a small garden and I was able to study them side by side; here *B. leucantha* had the involucral scales spreading at flowering time, while those of the glabrous *B. pilosa* were erect. I am inclined to regard *leucantha* as a distinct species. There is a race with undivided leaves.

6. THE GENUS MALACHE B. VOGEL.

Malache scabra was proposed by B. Vogel (Trew, Pl. Select. 50. *pl. 90.* 1772) as the name of a mangrove-swamp shrub common nearly throughout the West Indian region, subsequently called by Cavanilles (Diss. **3**: 136. *pl. 46. f. 1.* 1787) *Pavonia spicata*, and by Swartz (Fl. Ind. Occ. **2**: 1215. 1800) *Pavonia racemosa*. Trew cites pre-Linnaean names for the plant, and gives a detailed description and a beautiful illustration of it, especially referring to Sloane, Hist. Jam. 221. *pl. 139. f. 2*; Sloane's description and illustration are unmistakable for the species. Linnaeus does not appear to have had any name for it.

Pavonia Cav. has as its type species *P. spinifex* Cav. After studying quantities of this and of *Malache scabra*, both in the field and in the herbarium, I am confident that they should not be included in the same genus, inasmuch as they differ too widely in the floral and fruit-structure and in habit; only the most artificial classification can retain them as congeneric.

Malache scabra is a typical shrub of coastal swamps from Florida southward through the Caribbean region to Central America, Colombia, Trinidad, and Brazil, and is recorded as growing as far south as Peru on the western side of South America.

Having seen much of this species along mangrove swamps, nearly or quite always within the tidal influence at high water, I was surprised and interested while exploring the high rocky "Cockpit Country" of Jamaica with Mr. William Harris in September, 1907, to find a similar plant on hills in wet woods in the vicinity of Troy, reaching altitudes of at least 600 meters. Mr. Harris had collected fruiting specimens of it the year before, and had noticed its resemblance to the coastal shrub; Professor Urban has recently described it from these specimens (*Harris 9457*), as *Pavonia racemosa* var. *troyana* (Symb. Ant. **5**: 530. 1908). I obtained additional specimens both in flower and fruit in 1907 (*Britton 515*) and from field studies made then in comparison with *Malache scabra* I am convinced that this "Cockpit Country" plant is specifically distinct, and to be called **Malache troyana**; it has broader involucral bracts, much broader and differently shaped carpels, the anther-bearing part of the stamen-column proportionately shorter, and the fruiting peduncles are shorter and stouter. The plant is tall and slender and sometimes approaches the form of a small tree up to 4 or 5 meters high.

NEW YORK BOTANICAL GARDEN.

Some native weeds and their probable origin

Roland M. Harper

Every botanist who attempts to classify the vegetation of a populous region, such as the northeastern United States, is confronted at the outset with the problem of distinguishing the natural or undisturbed habitats from those which have been modified by civilization. Of course all our vegetation has felt the influence of civilization more or less, but it seems possible to draw a fairly sharp line between those habitats whose flora is essentially the same now as it was in prehistoric times and those where it has been so much altered that it is impossible to reconstruct the primeval conditions.

In general it seems to be true — and the task of the phytogeographer would be almost hopeless if it were otherwise — that external influences of slight amount or of short duration produce no permanent changes in vegetation. As an example of the first kind, when the pine trees are removed from an area of southern pine-barrens the amount of sunlight reaching the ground is increased probably not more than 10 per cent., and this seems to make no perceptible difference to the herbaceous vegetation.* But if the ground is then plowed up and cultivated, the original vegetation disappears, most of it never to return.†

In the second place, if a deciduous forest is destroyed by lumbermen or swept by fire it presents a very different appearance for a time, but if left undisturbed it will regain its former appearance and flora, or very nearly so, as soon as the trees have time to grow up again. But if the cutting or burning is repeated every few years the ground will gradually become covered with herbs and short-lived shrubs, among which it is difficult for trees to regain a foothold.

(This tendency of vegetation to restore itself seems to be quite analogous to elasticity in physics. For example, if any solid sub-

* See Ann. N. Y. Acad. Sci. 17 : 117. 1906.

† See Mohr, Contr. U. S. Nat. Herb. 6 : 120. 1901.

stance of suitable material and form, such as a copper wire, is bent slightly and released immediately it will quickly resume its original shape; but if bent too much or kept bent too long it will remain so.)

In New England and southern New York, to which the following discussion will be chiefly confined, the modification of plant environments through human agency has come about chiefly in the following six ways.

A. Trees of a forest destroyed by fire, lumbering, etc., and allowed to grow up again without delay. Forest fires of course occurred more or less before man existed, but their frequency has been so greatly increased by civilization that they may now without serious error be regarded as one of its effects.

B. Trees removed and then kept down by repeated mowing, burning, grazing, or trampling, as in hay-fields, railroad rights-of-way, pastures, lawns, roads, and paths.

C. Original vegetation all or nearly all destroyed and soil disturbed, as in cultivated and abandoned fields, embankments, and excavations. Similar conditions are sometimes, though rarely, brought about in a natural way by landslides, etc.

D. Foreign matter added to the soil, as in gardens, barnyards, waste places, railroad yards, and ballast grounds.

E. The amount of water changed, as in drained marshes and swamps, irrigated lands, ditches, and artificial ponds.

F. Entirely new substrata provided, such as roofs, walls, wharves, pavements, and refuse and artificial substances of all kinds.

The plants which follow treatment *A* are practically all native in the adjacent undisturbed forests or elsewhere in the vicinity, and those of *E* are also usually native, within a few miles at least. After *B* and *C*, European weeds are numerous, if not in the majority. The plants of *D* are nearly all exotics, and those of *F* are mostly cellular cryptogams of very wide distribution.*

---

* For the names of some of them see Meyen, Grundriss der Pflanzengeographie, 87–92. 1836 (or pages 73–78 of the English translation, 1846). The alleged new species of fungi which have been described in the last few years from such places as "a box where acetic acid had been spilled," and "among grasses where coal ashes had been lying," as well as the numerous native fungous parasites of exotic plants, are also to be classed here.

The plants of the various unnatural habitats created in the manners above indicated may also be classified as follows:

1. Species undoubtedly indigenous in our forests, which spring up quickly in clearings and to a lesser extent in other unnatural places, and tend to restore them to their original condition.

2. "Fireweeds," or species especially characteristic of recently burned woodlands, gradually disappearing with the process of reforestation. Some of them are herbs, some shrubs and some trees. If reforestation is prevented, as in case *B*, some of the fireweeds are apt to remain and behave like ordinary roadside or introduced weeds. There are probably hardly more than a score of typical fireweeds in the northeastern states, but very little is known as yet of their origin and history. Lists of such plants for various northeastern localities have been published as follows:

Dawson, Am. Jour. Sci. II. **4**: 164–166. 1847. (Nova Scotia.)

Thoreau, Maine Woods, appendix. (There are several editions, so it is hardly worth while to give date and page.)

Prentiss, Bull. Torrey Club **10**: 44. 1883. (Adirondacks.)

Chickering, Bot. Gaz. **9**: 193–194. 1884. (Maine.)

Sargent, Tenth Census U. S. **9**: 492, 497, 502–503, 510, 558. 1884.

Fernald, Trans. Mass. Hort. Soc. **1905**: 11. 1905.

Chittenden, U. S. Bureau Forestry Bull. **55**: 21, 37–38, 50–51, 67–70. 1905. (New Hampshire.)

3. Species native in naturally treeless or sparsely wooded dry areas in the same general regions, and therefore well adapted to such unnatural habitats as those under the second head. The naturally treeless areas of this part of the country, other than those of the seacoast and high mountains, are very imperfectly understood. The principal ones seem to be the "sand-plains" of the less elevated parts of New England, and the "Hempstead Plains" of Long Island, which resemble in aspect some of the western prairies. Existing botanical literature gives very little information about such places. Two lists of New England sand-plain plants were published in 1903; one by J. W. Blankinship (Rhodora **5**: 128, 129) for eastern Massachusetts, and one by W. E. Britton (Bull. Torrey Club **30**: 581–585) for southern Connecticut. Dr.

Blankinship's list is rather fragmentary, Dr. Britton's includes a number of introduced species, and neither is as sharply limited as it might have been. The flora of the Hempstead Plains, which is somewhat similar, has never been published, but it seems to comprise about 80 native species of vascular plants.

4. Species undoubtedly native in open woods, pine-barrens or prairies farther south and west, which have probably come into the northeastern states only since the clearing away of most of the forests has destroyed much of the humus and made the summers warmer. To this class probably belong a number of species of Compositae, Leguminosae, *Crataegus*, etc., but it would be difficult to specify any particular species.

5. Species which grew in Indian clearings before the white man came, so that it is now impossible to determine where they are really native. There is not much on record about these in the parts of our country which have been settled the longest. *Phytolacca decandra* is supposed to be one of them, and a few others of southern distribution are mentioned in Mohr's Plant Life of Alabama, page 54. Such plants are mostly to be looked for in the first three classes of unnatural habitats, and they cannot be very numerous.

6. Species not included in any of the five foregoing classes, supposed to be native in the eastern United States, but apparently confined to unnatural habitats, and behaving like introduced plants, from which they are to be distinguished in most cases only by documentary evidence. These will be discussed at length farther on.

7. Weeds naturalized from foreign countries, where most if not all of them have been accustomed to unnatural habitats for centuries. These occupy habitats of class *D* almost to the exclusion of natives, are very common in *C*, less so in *B*, rare in *A*, and are wanting in perfectly natural habitats. The number of weeds certainly known to have been introduced into this country is quite large, constituting at present in the northeastern states about 20 per cent. of the angiospermous flora.*

8. Exotic plants which grow spontaneously for a time, but are

* For an interesting discussion of some plants of this and the next class see Fernald's lecture on "Some recently introduced weeds" (Trans. Mass. Hort. Soc. 1905: 11–22. 1905).

not sufficiently adapted to our conditions to spread. These, often designated adventive or fugitive plants,* are confined chiefly to habitats *C* and *D*, especially the latter.

9. Cultivated plants, which are unable to compete with those in the other groups, and grow only where they are planted and protected by man, as in fields, gardens, hothouses, flower-pots, etc. In the northeastern states probably nine tenths of the species of this and the two preceding groups are of European origin.

It is with class 6, the native weeds, that we are chiefly concerned. A few lists of such plants for various parts of the eastern United States and neighboring territory have been published as follows:

NEW BRUNSWICK: Ganong, Bot. Gaz. **36**: 432, 435. 1903; **42**: 89–90, 98–99. 1906.

MAINE: Thoreau, Maine Woods (appendix).

VERMONT: Brainerd, Jones, & Eggleston, Fl. Vt. 94. 1900.

MASSACHUSETTS: Blankinship, Rhodora **5**: 128, 135. 1903.

PENNSYLVANIA: Harshberger, Bull. Torrey Club **31**: 152–155, 156–158. 1904.

MICHIGAN: Beal, 5th Rep. Mich. Acad. Sci. (Mich. Flora) 27. 1904; F. B. H. Brown, Bot. Gaz. **40**: 277. 1905; Transeau, Bot. Gaz. **40**: 435, 438, 440–441, 443–444, 446–447. 1905.

ILLINOIS: Brendel, Flora Peoriana 36. 1887.

VIRGINIA: Kearney, Contr. U. S. Nat. Herb. **5**: 407–409, 472. 1901.

TENNESSEE: Gattinger, Fl. Tenn. (ed. 2) 13–14. 1901.

GEORGIA: Harper, Bull. Torrey Club **27**: 327–328, 329, 421. 1900; **30**: 338. 1903; Ann. N. Y. Acad. Sci. **17**: 114–116. 1906.

ALABAMA: Mohr, Contr. U. S. Nat. Herb. **6**: 64 (near top), 65 (middle). 1901.

MISSISSIPPI and LOUISIANA: Lloyd & Tracy, Bull. Torrey Club **28**: 83. 1901.

It happens, however, that in all or nearly all of the lists just cited there is more or less admixture of exotics or of undisputed natives, or both. To illustrate therefore just what kind of plants I would call native weeds I offer the following examples, which I

* See in this connection Mohr, Contr. U. S. Nat. Herb. **6**: 53–56. 1901.

have observed in southern New England (mostly in Southbridge, Mass., and neighboring towns) and the western half of Long Island. Those to which interrogation points are prefixed may possibly belong to some of the eight other classes mentioned above, but they are mentioned to attract attention and invite discussion, by which their status may perhaps be settled.

? *Krigia virginica* (L.) Willd.
Lactuca canadensis L. (and perhaps others).
Achillea Millefolium L.
Bidens frondosa L. (and perhaps others).
Gnaphalium obtusifolium L.
Anaphalis margaritacea (L.) B. & H.
Erigeron ramosus (Walt.) B. S. P.
Leptilon canadense (L.) Britton.
Aster Novae-Angliae L.*
" *vimineus* Lam.
" *diffusus* Ait. (and several others).
Euthamia graminifolia (L.) Nutt.
" *caroliniana* (L.) Greene (and intermediate forms).
Solidago canadensis L.
" *nemoralis* Ait. (and some others).
Xanthium spp.
Ambrosia trifida L.
" *artemisiaefolia* L.
Lobelia inflata L.
Specularia perfoliata (L.) A. DC.
Sambucus canadensis L.†
Houstonia coerulea L.
? *Plantago major* L.
" *Rugelii* Decne.
Linaria canadensis (L.) Dumont.
Ilysanthes gratioloides (L.) Benth.
Mentha canadensis L.
? *Koellia virginiana* (L.) Britton.
Prunella vulgaris L.
Verbena urticaefolia L.
Convolvulus Sepium L.
Asclepias syriaca L.
? *Cornus candidissima* Marsh.
? *Ptilimnium capillaceum* (Michx.) Raf.
Kneiffia pumila (L.) Spach.
Oenothera biennis L. (and others).
Isnardia palustris L.
Viola (many species, especially the acaulescent blue-flowered ones).
Hypericum maculatum Walt.
" *mutilum* L.
Sarothra gentianoides L.
? *Celastrus scandens* L.
? *Rhus typhina* L.
Euphorbia maculata L.
" *Preslii* Guss.
Acalypha virginica L.
" *gracilens* Gray.
? *Polygala verticillata* L.
Oxalis (the yellow-flowered ones).
? *Lespedeza* (several species).
Cassia marylandica L.
Chamaecrista spp.
Crataegus (many species).
Agrimonia spp.
Potentilla simplex Michx. (and others).
? *Fragaria virginiana* Duchesne.
? " *americana* (Porter) Britton.
Rubus spp. (numerous blackberries).
Lepidium virginicum L.
Cardamine hirsuta L.
Ranunculus abortivus L.
? *Anemone cylindrica* Gray.
Silene antirrhina L.
? *Polygonum aviculare* L.
" *erectum* L.
" *pennsylvanicum* L.
? " *Hydropiper* L.
? " *sagittatum* L.
" *scandens* L.
? *Rumex Acetosella* L.
Urtica gracilis Ait.
? *Salix discolor* Muhl. (and others).

* See Torreya 7: 173. 1907.

† See Gray, Am. Nat. 1: 493–44. 1867; 2: 38–39. 1868; Allison, Auk 21: 473. 1904; Harper, Ann. N. Y. Acad. Sci. 17: 154. 1906.

Sisyrinchium (several species).
? *Smilax rotundifolia* L.
? *Juncus effusus* L.
" *marginatus* Rostk.
? " *bufonius* L.
" *tenuis* Willd. (and probably others).
? *Spirodela polyrrhiza* (L.) Schleid.
? *Carex lurida* Wahl.
? " *pallescens* L.
" *festucacea* Willd.
? " *Muhlenbergii* Schk. (and probably a few others).
? *Fimbristylis autumnalis* (L.) R. & S.
Eleocharis obtusa (Willd.) Schult. (and perhaps others).
? *Cyperus filiculmis* Vahl.
Eragrostis pectinacea (Michx.) Steud.
Eragrostis Purshii Schrad.
Agrostis hiemalis (Walt.) B. S. P.
? *Sporobolus vaginaeflorus* (Torr.) Vasey.
? *Aristida gracilis* Ell.
" *dichotoma* Michx.
Muhlenbergia mexicana (L.) Trin. (and perhaps others).
Chaetochloa spp.
Panicum (several species).
? *Syntherisma sanguinale* (L.) Nash.
" *filiforme* (L.) Nash.
Paspalum setaceum Michx. (and perhaps others).
? *Andropogon* spp.
? *Juniperus communis canadensis* Loud.*
? *Equisetum arvense* L.
? *Botrychium obliquum* Muhl. (and some allied forms).

In the southeastern states there are many other species in the same category, and a complete list would probably include something like 10 per cent. of the species of flowering plants supposed to be indigenous in the eastern United States. How to treat these plants in phytogeographical works is therefore an important question.

If they are indigenous, but now confined to unnatural habitats, the first inquiry that suggests itself is: where did they grow a few hundred years ago, when their present habitats did not exist? Unfortunately, New England and New York were pretty well settled before botany became a science, and by the time American botanists began to study vegetation, rather than plants merely, there were nearly as many roads, pastures, clearings, etc., as there are today, so early botanical literature throws little light on the subject. Several explanations have been suggested, and each may account for some species, but none will satisfactorily cover all cases.

In the first place, it seems to be a common belief among those northeastern botanists who have given any thought to the matter that in prehistoric times all our native weeds occupied natural openings in the forests, which have now been completely obliter-

* See U. S. Forestry Bull. **55**: *pl. 5. f. 1.* 1905. This is a shrubby form of *Juniperus communis*, which has gone by several different names in recent years.

ated, and that the multiplication of clearings has given these plants opportunity to become widely disseminated. The chief objection to this theory is that the only naturally treeless areas in New England and New York (as far as can be ascertained from botanical literature) seem to be bodies of water, marshes, meadows, sand-plains, dunes, high cliffs, and mountain summits;* and few if any of the plants in question belong to such habitats. But even granting that there could have been natural openings of a kind which no longer exist in their original form, if all our native weeds inhabited them their flora must have been far richer in proportion to area than that of any other habitat known in the eastern United States today, which is incredible.

It would seem therefore that the only possible explanation for most of these species is that they have originated in some manner or other in the last few centuries, as I ventured to suggest in the case of some Georgia weeds not long ago.† Some of the species in question may even have originated within the last fifty years or so, for it is scarcely conceivable that all the new species of *Aster*, *Viola*, *Crataegus*, *Rubus*, etc., which have been described from unnatural habitats in recent years could have been overlooked by the botanists of a century ago, if the plants existed then. Our herbaria do not help us much in this particular, for specimens more than fifty years old are very rare, and almost never cited in the descriptions of new species.

There is more than one way of accounting for the modern origin of some of these species. Dr. Brainerd‡ has sagely suggested that the great multiplication of species of *Viola*, *Crataegus*, *Panicum*, etc., is chiefly due to increased opportunities for hybridization; which seems to be a modification of Kerner's§ theory that

---

* According to Thoreau the only openings in the Maine woods, about the middle of the 19th century, were rivers and lakes, burns and clearings, mountain summits, and perhaps a few meadows. The few plants of this class mentioned by him grew in burns and clearings. There are some evidences of about two square miles of dry land naturally treeless among the Adirondacks in Hamilton Co., N. Y., 1,855 feet above sea-level (see Field & Stream 12: 490. Oct. 1907, and the West Canada Lakes topographic sheet of the U. S. Geological Survey), but there seems to be nothing on record about its flora.

† Ann. N. Y. Acad. Sci. 17: 116. 1906.

‡ Rhodora 8: 10. 1906.

§ Pflanzenleben 2: 582–588. 1891. (English translation, "Natural History of Plants" 2: 595–600.)

all species now living originated by hybridization. But although the occurrence of natural hybrids has been demonstrated in some of the genera listed and strongly suspected in others,* hybridization would hardly increase the number of species ten-fold in *Crataegus* for instance in so short a time. And some of the genera are still so small that the possible hybrids in them must be very limited in number.

For the large number of cases still unexplained we shall probably have to fall back on the mutation theory, as being the only other one which explains the sudden origin of new forms. Only a few well-authenticated cases of mutation have hitherto been detected, and there is still considerable diversity of opinion as to the cause of the phenomenon. De Vries seemed to think that each species passes through periods of mutation at long intervals, and that his epoch-making discovery was largely due to the fact that he happened to have a mutating species of *Oenothera* under careful observation just at the critical period. MacDougal has succeeded in inducing mutation, or something that looks very much like it, in the same genus by artificial means, and from this he infers that the cause of mutation may at least in some cases be external to the plant.† Blaringhem seeks this external cause in mechanical injuries (such as cutting the stem) at the time of maximum vegetative activity.‡ This seems quite plausible in view of the fact that de Vries's Oenotheras are said to have grown in a field which was cut over sometimes, and most of our meadow and roadside plants get similar treatment every year.

Although the writer does not claim to be familiar with the physiological aspects of the mutation theory or theories, it seems to him perfectly reasonable to suppose that change of environment alone may be a sufficient cause, or stimulus, of mutation, or at least of rapid evolution. Indeed it is more than likely that all evolutionary changes (other than hybridization) in the vegetable kingdom have been preceded by changes of environment. Geological history confirms this view, for one of its most prominent features is the great difference in the organisms of successive periods, the

* See MacDougal, Bot. Gaz. **43**: 57. 1907.
† See Yearbook, Carnegie Inst. **5**: 129. 1907.
‡ Mutation et Traumatismes. Paris, 1907.

intervals between which were marked by great and rapid changes on the earth's surface.* Another circumstance which points to the same conclusion is that closely related species do not usually occupy the same habitat, as every experienced field worker knows.†

An extremely significant point is that no case of mutation seems to have hitherto been detected in any species whose environment has not been disturbed by civilization. All plants now being studied which give promise of mutation phenomena are either weeds or cultivated plants. Probably no species can come into close contact with civilization for any length of time without being more or less modified sooner or later. As Dr. H. J. Webber said about ten years ago:‡ "No instance is known of a plant being long under cultivation and not furnishing several varieties."

Most of our introduced weeds, or rather their ancestors, doubtless experienced the same change of environment in the Old World centuries ago that our native weeds have in more recent times; and the first step in the economic development of every one of our cultivated plants which is no longer known in the wild state must have been the creation of a new environment for it, purposely or otherwise.

Against the comparatively sudden origination of new forms under the pressure of changed environment might be urged the often cited experiments of European botanists who have transplanted alpine plants to lowlands and vice versa without producing any permanent or inheritable variations thereby. The answer to this is that probably such experiments have not been continued long enough. For all we know, a century or more of exposure to different conditions may be necessary in most cases to start mutation, or "break the type," as Dr. Webber puts it. Some species are doubtless more susceptible than others,§ and those experi-

---

* See the papers by Dall, King, LeConte, and White, cited below.

† See in this connection Abrams, Science II. **22**: 836–838. 22 D 1905.

‡ Yearbook U. S. Dept. Agr. **1896**: 103. 1897.

§ This might be inferred from the fact that in the foregoing list such large families as Gentianaceae, Ericaceae, Umbelliferae, Orchidaceae, and Liliaceae are not represented at all, and some others very sparingly in proportion to their numbers. Woody plants must change more slowly than herbs, and this is perhaps one reason why the species of *Crataegus* and *Rubus* have not been greatly multiplied by systematists until lately.

mented with might have happened to be among the least susceptible.

Another important point to be considered is that if our native weeds have sprung into existence in modern times, they should all be closely related to species that are undoubtedly native. This indeed seems to be true in most cases; and the rest deserve further investigation. It seems very likely that in this class of plants we may have many examples of polygenesis, i. e., of a single species originating independently at several or many different places; a phenomenon whose possibility was denied by Darwin and some of his successors.*

The suggestion that mutation may be induced by civilization is not exactly a new one, for premonitions of it have appeared in one form or another in the writings of botanists and zoölogists several times in the last few years,† and one occasionally hears interesting rumors about it from persons who have not ventured to put their ideas on the subject into print; but it does not seem to have attracted much attention yet, especially among systematists, many of whom are going right on describing "new species" from unnatural habitats without inquiring into their history or making any distinction between them and species which are truly indigenous to our primeval forests.‡

To admit the modern origin of native weeds would simplify a number of vexed problems, and put an end to many of the fruitless discussions of the indigeneity of certain species which have been going on in some of our botanical journals.§ It would also partly explain the greater richness of the herbaceous flora of Great

---

* See Clements, Bot. Surv. Neb. 7: 68–77. 1904; Research methods in ecology 230–232. 1905.

† See Dunn, Jour. Bot. 40: 359. 1902; Spalding, Plant World 10: 140. Je 1907; Cockerell, Science II. 26: 72–73. 19 Jl 1907.

‡ As recently as August, 1907, a prominent systematist has published the following statement (Jour. Bot. 45: 290): "The origin of these many forms [of *Crataegus* in North America] I cannot pretend to account for. The theory that they are hybrids of recent origin, however, can hardly be accepted."

§ In one magazine alone, the Journal of Botany, I have noticed discussions of this kind (mostly relating to British plants) at the following places in the last twelve volumes: 34: 201–204. 1896; 37: 356–358. 1899; 40: 356. 1902; 41: 141–142, 150–154, 285, 289–290. 1903; 43: 89–94. 1905; 44: 138–142, 207–213, 390. 1906.

Britain, New England, etc., as compared with more newly and thinly settled regions of equal area and diversity. For in these old countries few if any native species have yet been completely exterminated, while the flora has been greatly augmented by the species which seem to have been produced to meet the new conditions of environment, to say nothing of introduced species, which must have originated in a similar manner somewhere else.

Furthermore, it will be noticed that the list given contains the names of the genera which in the past decade or two have furnished the most employment for species-makers in this part of the world; such as *Achillea*, *Bidens*, *Aster*, *Viola*, *Euphorbia*, *Oxalis*, *Lespedeza*, *Chamaecrista*, *Rubus*, *Agrimonia*, *Polygonum*, *Salix*, *Sisyrinchium*, *Smilax*, *Juncus*, and *Panicum*. By analogy we may expect some of the other genera to prove equally polymorphous before long. European botanists have long been having similar troubles with *Hieracium*, *Crepis*, *Centaurea*, *Cirsium*, *Campanula*, *Galium*, *Orobanche*, *Euphrasia*, *Euphorbia*, *Astragalus*, *Trifolium*, *Rubus*,* *Rosa*, *Potentilla*, *Saxifraga*, *Ranunculus*, *Fumaria*, *Erysimum*, *Silene*, *Dianthus*, *Crocus*, *Carex*,† *Festuca*, *Poa*, *Avena*, and numerous other genera, and doubtless for similar reasons.

Such plants as these, however interesting they may be to the horticulturist, economic botanist, evolutionist, and laboratory worker, have no place in a description of the natural or primeval vegetation of the country, and their study can throw but little light on the pre-historic development of the native flora, which is one of the chief concerns of the phytogeographer. Their number will probably continue to increase as long as the population of the earth increases, and when they are described it would seem desirable to keep them by themselves, like cultivated plants, instead of cumbering the pages of our manuals with them, to the confusion and despair of the average botanist. In the present state of our knowledge it may seem impossible to make a sharp distinction between native weeds and members of the original flora; but authors

---

* The perplexities of this genus in Europe are so great that English botanists have invented a special name, "batologists," for those who study it most.

† *Carex*, although one of our largest genera, has not furnished as many "new species" in the Eastern United States in the last fifty years as several formerly much smaller genera have. May this not be correlated with the fact that very few of our *Carices* are found in unnatural habitats?

of new species hereafter might at least do a great service to their successors by describing the habitats as explicitly and systematically as possible in every case. Habitat has been almost universally regarded by systematists as a matter of minor importance, or ignored entirely; but inasmuch as it represents the combined expression or resultant of geological history and all the properties and adaptations of the species, its importance cannot be overestimated.*

The following works (most of which have not been mentioned in the foregoing pages), together with the references given in some of them, bear more or less directly on the subject under discussion.†

Blaringhem, Louis. Mutation et traumatismes. 1–248. *pl.* 1–8. Paris, 1907. (From Bull. Sci. de la France et de la Belgique, vol. 41.) Reviewed by W. C. W[orsdell] in Jour. Bot. **46**: 201–203. Je 1908.

Dall, W. H. On a provisional hypothesis of saltatory evolution. Am. Nat. **11**: 135–137. Mr 1877.

Dawson, J. W. On the destruction and partial reproduction of forests in British North America. Am. Jour. Sci. II. **4**: 161–170. S 1847. (Deals especially with succession of vegetation in burned areas.)

Dunn, S. T. Origin of the deadnettles in Britain. Jour. Bot. **40**: 356–360. O 1902. Discussed by E. S. Marshall in the next number (390–391).

Dunn, S. T. A preliminary list of the alien flora of Britain. 1–30. 1903. (Not seen.) Reviewed in Jour. Bot. **41**: 141–142. Ap 1903; and discussed by H. J. Riddelsdell in same, **43**: 89–94. Mr 1905.

Dunn, S. T. Alien flora of Britain. i–xiv + 1–208. 1906. (Not seen.) Reviewed by H. J. Riddelsdell in Jour. Bot. **44**: 138–142. Ap 1906; and discussed by E. S. Marshall in same, 207–213. Je 1906.

---

*In this connection pages 10–11 of Dr. B. L. Robinson's address on "The problems of ecology" (read before the "Congress of Arts and Science" in St. Louis in 1904, and reprinted in 1906 from the fifth volume of the proceedings of the Congress) are well worth reading.

†Some of these I have seen only in the library of the Staten Island Association of Arts and Sciences. For the privilege of examining most of the remainder I am indebted to the New York Botanical Garden.

Gilbert, E. G. A note on hybrids. Jour. Bot. **41**: 348–359. O 1903. (Refers to *Rubus* mostly.) Discussed by E. S. Marshall in the next number (379).

Gray, Asa. The pertinacity and predominance of weeds. Am. Jour. Sci. III. **18**: 161–167. 1879. (Reprinted in his Scientific Papers **2**: 234–242. 1889.)

Halsted, B. D. American and English weeds compared. Plant World 3: 171–173. N 1900.

King, Clarence. Catastrophism and evolution. Am. Nat. **11**: 449–470. Au 1877.

LeConte, Joseph. On critical periods in the history of the earth, and their relation to evolution; on the Quaternary as such a period. Am. Jour. Sci. III. **14**: 99–114. Au 1877; Am. Nat. **11**: 540–557. S 1877.

MacDougal, D. T. Heredity and environic forces. Science II. **27**: 121–128. 24 Ja 1908. (Vice-presidential address, Section G, A. A. A. S.)

Malinvaud, Ernest. The species and hybrids of *Mentha*. (Translated from the French.) Jour. Bot. **38**: 171–174. Ap 1900. (See also Plant World **10**: 139. Je 1907.)

Rothrock, J. T. A nascent variety of *Brunella vulgaris* L. Contr. Bot. Lab. Univ. Pa. **1**: 64–65. 1892. (See also Amer. Bot. **13**: 21. S 1907.)

Thoreau, H. D. The Maine woods. (Originally published in 1864. My copy is an 18mo, with 359 pages and an introduction, published by T. Y. Crowell & Co. of New York in 1906. The list of plants occupies pages 329–348.)

Webber, H. J. Influence of environment in the origination of plant varieties. Yearbook U. S. Dept. Agr. **1896**: 89–106. *f. 16–23.* 1897. (A very interesting and valuable paper, which does not seem to have received the recognition it deserves, though the author is well known.)

White, C. A. The relation of phylogenesis to historical geology. Science II. **22**: 105–113. 28 Jl 1905.

Studies in North American Peronosporales—III. New or noteworthy species*

GUY WEST WILSON

Albugo Trianthemae sp. nov.

Soris hypophyllis, rotundis vel irregularibus, rarius confluentibus, immersis, promentibusque, subflavidis, 1–10 mm. latis, conidiophoris cylindraceis, circa 10 × 60 μ; conidiis subflavidis, breviter cylindraceis, circa 8–10 μ × 8–10 μ, terminalibus majoribus, circa 9–11 μ × 12–14 μ, membrana hyalina, ad medium annulo cincta; oosporis in foliis hospitis, globosis, 60–80 μ diametro, episporis brunneis, regulariter vel irregulariter reticulatis, areolis circa 4 μ latis.

Sori hypophyllous, rounded or irregular in outline, rarely confluent, rather deep-seated, prominent, yellowish, 1–10 mm.; conidiophores cylindric, about 10 × 60 μ; conidia short-cylindric, 8–10 μ × 8–10 μ, the terminal larger, 9–11 μ × 12–14 μ, membrane hyaline, with an equatorial thickening, contents light yellow, oöspores produced in the leaves of the host with the conidia, globular, 60–80 μ, averaging about 70 μ, epispore dark brown, rather closely and shallowly reticulate, areolae regular or irregular, about 4 μ.

Type in herb. Wilson, and duplicates of the same collection in herb. Underwood and the herbarium of the New York Botanical Garden. Collected by E. O. Wooton near Las Cruces, New Mexico, on *Trianthema Portulacastrum* L.

This species stands between *Albugo occidentalis* and *A. platensis*, being distinguished from the former by its larger conidia, which are lighter in color and dissimilar in size, and by its larger and darker oöspore, which is less regularly and more deeply reticulate; and from the latter by its cylindric conidia with the membrane similarly colored throughout, and by its larger and less deeply reticulate oöspore. The conidia are also quite similar to those of *A. Tragopogonis* but the oöspores are not tuberculate. The host suggests an affinity with *A. Portulacae*, but the annulate, dissimilar conidia and the absence of the tubercles in the areolae of the oöspore preclude such a relationship.

* Presented before Section G, A. A. A. S., at Chicago, Dec. 31, 1907, as "New or noteworthy Peronosporales."

Albugo Froelichiae sp. nov.

Albugo Cladothricis G. W. Wilson, Science II. **27**: 207. 1908. (Hyponym).

Soris hypophyllis vel in caulibus, superficialibus prominentibusque, albis vel subflavidis, subrotundis vel irregularibus, 1–3 mm. latis; conidiophoris subfusiformibus, elongatis, 12–18μ×70–85 μ; conidiis subflavidis, breviter ellipticis, terminalibus minoribus, globosis, 10–18 μ × 12–20 μ, membrana subflavida, ad medium annulo cincta; oosporis in foliis hospitis, brunneis, globosis, 45–80 μ; episporis irregulariter vel regulariter reticulatis, areolis circa 7 μ latis.

Sori hypophyllous or caulicolous, prominent, superficial, white or light yellowish, rounded or irregular in outline, 1–3 mm.; conidiophores long, somewhat fusiform, 12–18 μ× 70–85 μ; conidia uniformly light yellow throughout, short-elliptic, 10–16 μ× 12–18 μ, the terminal smaller, globose, the membrane with an equatorial thickening; oöspores produced in the leaves of the host, globose, 45–80 μ, averaging 70 μ; epispore dark brown, rather opaque, coarsely and irregularly, or even regularly reticulate, areolae about 7 μ.

Type in herb. Wilson and duplicate in the herbarium of the New York Botanical Garden, collected by W. H. Long, at Denton, Texas, on *Froelichia gracilis* Moq.

ON AMARANTHACEAE:

Cladothrix lanuginosa (Moq.) Nutt., Kansas, *Hitchcock 431*; New Mexico, *Wooton;* Mexico, *Berlandier.*

Froelichia campestris Small, Texas, * *Long* [Fungi Columb. *2407*, "on *F. floridiana* (Moq.) Nutt."].

Froelichia gracilis Moq., Texas, * *Long* (type).

DISTRIBUTION: Kansas to Mexico.

The present species is very closely related to *A. Bliti* and *A. platensis*, but is distinguishable from the former by its yellowish sori and its yellow conidia, while it is easily separated from the latter by its conidia, which are brighter yellow, and never show the dark ring of that species. The conidia also separate it from the preceding species, to which it is closely related. The conidiophores are unique within the genus for their fusiform outline. The oöspores are very similar to those of *A. Bliti* but are larger in size.

PHYTOPHTHORA THALICTRI Wilson & Davis

Material of this species collected by Dr. Davis later in the season than the type collection indicated that the species is rather well distributed over southeastern Wisconsin. Although a careful search was made in New York in the early summer and in Indiana in the late summer, the species was not found in either locality. Dr. Davis observed the germination of the conidia, which behave in the typical manner for the genus.

PERONOSPORA CYPARISSIAE de Bary

This species is reported by T. A. Williams from South Dakota on *Euphorbia glyptosperma* Engelm. and *E. maculata* L.* An examination of this material shows the species in question to be *Peronospora Euphorbiae* Fuckel, the only species so far detected on North American Euphorbiaceae. The two fungi in question infest widely separated sections of the old genus *Euphorbia*.

PERONOSPORA RUMICIS Corda

The species has been recorded from North America on *Polygonum aviculare* L., *P. dumetorum* L., and *P. scandens* L. European mycologists recognize two species of *Peronospora* on Polygonaceae, *P. Rumicis* Corda on *Rumex* spp. and *P. Polygoni* Thümen on *Polygonum* spp. The two fungi are separated by differences of both conidia and conidiophores. *P. Rumicis* has conidiophores 3–6 times branched, with very short ultimate branchlets (2–4 μ long) and broadly ellipsoid conidia (26–33 μ × 16–23 μ), while *P. Polygoni* has conidiophores more lax, 5–7 times branched, the ultimate branchlets long (6–12 μ) and often curved, and elongate conidia (30–40 μ × 15–20 μ). The latter species is rather widely distributed in the northern United States, while the former, so far as my own observations go, has not been substantiated by authentic material from our region, nor do any of the recorded hosts indicate its presence in North America.

PERONOSPORA ARBORESCENS (Berk.) de Bary

In his report upon a collection of western Fungi Hume† records *Peronospora Corydalis* de Bary on *Argemone platyceras*

* Bull. Torrey Club 19 : 82. 1891.

† Proc. Davenport Acad. Sci. 7 : 254. 1899.

Coulter from Colorado. The close relationship between this and the usually recognized hosts of *P. Corydalis* gave the determination an air of probability which might not have been questioned were it not for the fact that another species, *P. arborescens*, is known in Europe and Asia on various species of *Papaver*. A careful comparison of the material in question with authentic European material of both the species in question shows that the American material belongs to *P. arborescens*, a species not heretofore recorded for North America.

PERONOSPORA FLOERKEAE Kellerman

This species has so far been recorded only from central Ohio and central Indiana. About the same time Dr. Kellerman collected the type material Mr. H. S. Jackson of the Delaware Experiment Station collected it in the vicinity of Newark, Delaware, and Mr. Holway collected it on the Wisconsin side of the Mississippi opposite some Minnesota point. From these new records it appears that the fungus and host are coextensive in range.

PERONOSPORA NICOTIANAE Speg.

This species was originally described by Spegazzini from Buenos Aires on *Nicotiana longiflora* * and later recorded by him on various other species of the same genus from this general region. From Buenos Aires there has been introduced into California, Texas and northern Mexico *Nicotiana glauca*, upon which in 1885 Dr. Farlow collected a *Peronospora* in California. This material was determined and distributed as *P. Hyoscyami* de Bary and records of its occurrence published in this country and copied abroad.† The European species of *Hyoscyamus* appear to harbor two species of *Peronospora*, *P. Hyoscyami* and *P. dubia*, the first of which bears a superficial resemblance to our species, while the second would never be confused with it. Both, however, belong to Berlese's section *Intermediae*, while our species belongs to the *Divaricatae*. Evidently, then, the European and American species are distinct. A comparison of our material with the de-

* Rev. Argent. Hist. Nat. 1: 36. 1 F 1891.

† Bot. Gaz. 10: 246. 1885. Gardeners' Chron. II. 9: 211. 1891.

scription of Spegazzini's species shows a close conformity thereto and leaves no doubt as to their identity, although no South American material is at hand for comparison. Judging from the origin of the host, it is not improbable that both host and fungus were introduced into the Southwest at the same time, although this is not one of the species recorded by Spegazzini as a host of *Peronospora Nicotianae*.

Inasmuch as the description of the species is rather inaccessible it is not unfitting to append a brief characterization:

Hypophyllous, forming brownish discolorations on the leaves; conidiophores erect, 250–500 μ × 10–12 μ, 6 or 7 times dichotomously branched, ultimate branchlets 15–18 μ × 2–3 μ, divaricate, acute; conidia ellipsoid or ovoid, 18–20 μ × 9–11 μ, very light violet; oögones globose, angled, hyaline, 80–100 μ; oöspores 50–80 μ, globose; epispore subopaque, closely reticulate, the areolae slightly elongate.

NEW YORK BOTANICAL GARDEN.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1908)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

This Index is reprinted monthly on cards, and furnished in this form to subscribers, at the rate of one cent for each card. Selections of cards are not permitted; each subscriber must take all cards published during the term of his subscription. Correspondence relating to the card-issue should be addressed to the Treasurer of the Torrey Botanical Club.

Ames, O. Notes on *Habenaria*. - Rhodora **10**: 70, 71. 16 My 1908.

Andrews, F. M. An abnormal *Porella platyphylla*. Bot. Gaz. **45**: 340. *f. 1–3*. 15 My 1908.

Arthur, J. C. A search for rusts in Colorado. Plant World **11**: 69–77. Ap 1908.

Arthur, J. C. The physiologic aspect of the species question. Am. Nat. **42**: 243–248. 18 My 1908

Benedict, R. C. Studies in the *Ophioglossaceae* — II. A descriptive key to *Botrychium* in North America: group of *B. lanceolatum*. Torreya **8**: 100–103. 19 My 1908.

Berry, E. W. Some Araucarian remains from the Atlantic coastal plain. Bull. Torrey Club **32**: 249–259. *pl. 11–16. f. 1, 2.* 29 My 1908.

Bessey, C. E. The taxonomic aspect of the species question. Am. Nat. **42**: 218–224. 18 My 1908.

Bessey, E. A. The Florida strangling figs. Ann. Rep. Missouri Bot. Gard. **19**: 25–33. *pl. 1–9.* 4 Mr 1908.

Britton, N. L. The taxonomic aspect of the species question. Am. Nat. **42**: 225–242. My 1908.

Britton, N. L. North American trees. i–x + 1–894. *f. 1–781.* New York. [9 My] 1908.

With the assistance of **J. A. Shafer.** Includes new species in *Juniperus*, *Populus*

(2), *Salix*, *Amelanchier*, *Acacia*, *Acer* (2), *Bumelia*, and *Fraxinus* (3); *Nuttphonia* Shafer, nom. nov. for *Styphonia* Nuttall; and *Canotiaceae* Britton fam. nov.

Brown, A. The Elgin Botanic Garden: its later history and relation to Columbia College, the New Hampshire Grants, and the treaty with Vermont in 1790. i–iv + 1–57. Lancaster, Pa. 1908.

Reprinted in advance from Bull. N. Y. Bot. Gard. **15**: 319–372.

Brown, H. B. Algal periodicity in certain ponds and streams. Bull. Torrey Club **35**: 223–248. *f. 1–3.* 29 My 1908.

Bureau, E. Notice historique sur F. M. Glaziou. Bull. Soc. Bot. France **55**: 119–125. *pl. 55.* 7 Ap 1908.

Campbell, D. H. Collecting liverworts in Java. Torreya **8**: 103–110. 19 My 1908.

Clements, F. E. An ecologic view of the species conception. Am. Nat. **42**: 253–264. 18 My 1908.

Clute, W. N. A pedate form of bracken. Fern Bull. **16**: 33–35. [Je] 1908. [Illust.]

Clute, W. N. New station for a rare Florida fern. Fern Bull. **16**: 38. [Je] 1908.

Clute, W. N. On some New Zealand ferns. Fern Bull. **16**: 42–45. [Je] 1908.

Clute, W. N. *Nephrodium patens* and *Nephrodium molle.* Fern Bull. **16**: 49, 50. [Je] 1908. [Illust.]

Clute, W. N. The Boston fern and its sports. Fern Bull. **15**: 73–74. [Je] 1908.

Cockerell, T. D. A. Variation in *Helianthus.* Bot. Gaz. **45**: 338. 15 My 1908.

Collins, F. S. *Oedogonium Huntii* rediscovered? Rhodora **10**: 57, 58. 16 My 1908

Collins, J. F. Preliminary lists of New England plants. XIX—Addenda. Rhodora **10**: 71, 72. 16 My 1908.

Cooper, W. S. Alpine vegetation in the vicinity of Long's Peak, Colorado. Bot. Gaz. **45**: 319–337. *f. 1–8.* 15 My 1908.

Copeland, E. B. New or interesting Philippine ferns: III. Philipp. Journ. Sci. **3**: 31–37. *pl. 1–6.* F 1908.

Includes new species in *Lygodium* (2), *Drynaria*, *Asplenium*, and *Davallodes* (2 · gen. nov.

Coulter, J. G. Opportunities in botany. Science II. **27**: 873–876. 5 Je 1908.

Cowles, H. C. An ecological aspect of the conception of species. Am. Nat. **42**: 265–271. 18 My 1908.

Dachnowski, A. Type and variability in the annual wood-increment of *Acer rubrum* L. Ohio. Nat. **8**: 343–349. *f. 1.* My 1908.

Davidson, A. The *Delphinii* of southern California. Muhlenbergia **4**: 33–37. 3 Je 1908.

DeCandolle, C. *Begoniaceae* novae. Bull. Herb. Boiss. II. **8**: 309–328. *f. 1, 2.* 2 My 1908.

Includes new species in *Begonia* (20), and in *Semibegoniella*, gen. nov.

Eames, A. J. *Sparganium diversifolium*, var. *acaule* in Massachusetts. Rhodora **10**: 56. 4 Ap 1908.

East, E. M. Suggestions concerning certain bud variations. Plant World **11**: 77–83. Ap 1908.

Edwards, A. M. The origin of petroleum in California. Nuova Notar. **19**: 72–78. Ap 1908.

Edwards, A. M. The origin of the *Bacillaria*. Nuova Notar. **19**: 79–84. Ap 1908.

Eggleston, W. W. *Crataegus* in New Mexico. Torreya **7**: 235, 236. 16 Ja 1908.

Includes *C. Wootoniana* sp. nov.

Eggleston, W. W. *Crataegi* of the northeastern United States and adjacent Canada. Rhodora **10**: 73–84. 4 Je 1908.

Includes *C. Grayana* sp. nov. and *C. rotundifolia Bicknellii* var. nov.

Eichlam, F. Mitteilungen aus Zentral-Amerika. Monats. Kakteenk. **18**: 33–35. 15 Mr 1908; 57–59. 15 Ap 1908.

Evans, A. W. *Leucolejeunea*, a new genus of *Hepaticae*. Torreya **7**: 225–229. 16 Ja 1908.

Fawcett, W. Historical notes on economic plants in Jamaica — VII. Tobacco. Bull. Dept. Agr. Jamaica **6**: 46–59. 1908.

Fernald, M. L. *Lemna minor* and *Sparganium eurycarpum* in Rimouski County, Quebec. Rhodora **10**: 95, 96. 4 Je 1908.

[Gibson, H. H.] American forest trees—74. Yellow birch, *Betula lenta* Michx. Hardwood Record **26**[2]: 16, 17. 10 My 1908. [Illust.]

[Gibson, H. H.] American forest trees — 75. *Picea canadensis* Mill. Hardwood Record **26**[3]: 16, 17. 25 My 1908. [Illust.]

[Gibson, H. H.] American forest trees—76. Box elder, *Acer Negundo* Linn. Hardwood Record **26**[4]: 16. 10 Je 1908. [Illust.]

Graves, H. S. The study of natural reproduction of forests. Forestry Quart. **6**: 115–137. Je 1908.

Greenman, J. M. Notes on the genus *Senecio*. Rhodora **10**: 68, 69. 16 My 1908.

Griggs, R. F. An undescribed *Heliconia* in the New York Botanical Garden. Torreya **7**: 230–233. *f. 1.* 16 Ja 1908.

Bihai geniculata Griggs, sp. nov.

Grout, A. J. Mosses with hand-lens and microscope 4: 247–318. *pl. 57–75 + f. 134–165.* New York. Ap 1908.

Gürke, M. Neue Kakteen-Arten aus Brasilien. Monats. Kakteenk. **18**: 52–57. 15 Ap 1908. [Illust.]

Pilocereus setosus, *Cereus leucostele*, *C. catingicola*, and *C. phaeacanthus* spp. nov.

Gürke, M. *Rhipsalis tetragona* Web. Monats. Kakteenk. **18**: 74. 15 My 1908. [Illust.]

Gürke, M. Bemerkungen zu *Melocactus guatemalensis* Gürke et Eichlam. Monats. Kakteenk. **18**: 60–62. 15 Ap 1908.

Hagström, O. New Potamogetons. Bot. Notiser **1908**: 97–108. *f. 1–14.* Ap 1908.

Includes *P. ziziiformis* sp. nov. from Brazil.

Harrison, A. K. *and others.* Reports on the flora of the Boston district — II. Rhodora **10**: 59–64. 16 My 1908.

Harshberger, J. W. The water-storing tubers of plants. Bull. Torrey Club **35**: 271–276. *pl. 17.* 29 My 1908.

Heller, A. A. New combinations. Muhlenbergia **7**: 40. 3 Je 1908.

Hemsley, W. B. *Tillandsia Blokii.* Curt. Bot. Mag. **4**: *pl. 8192.* My 1908.

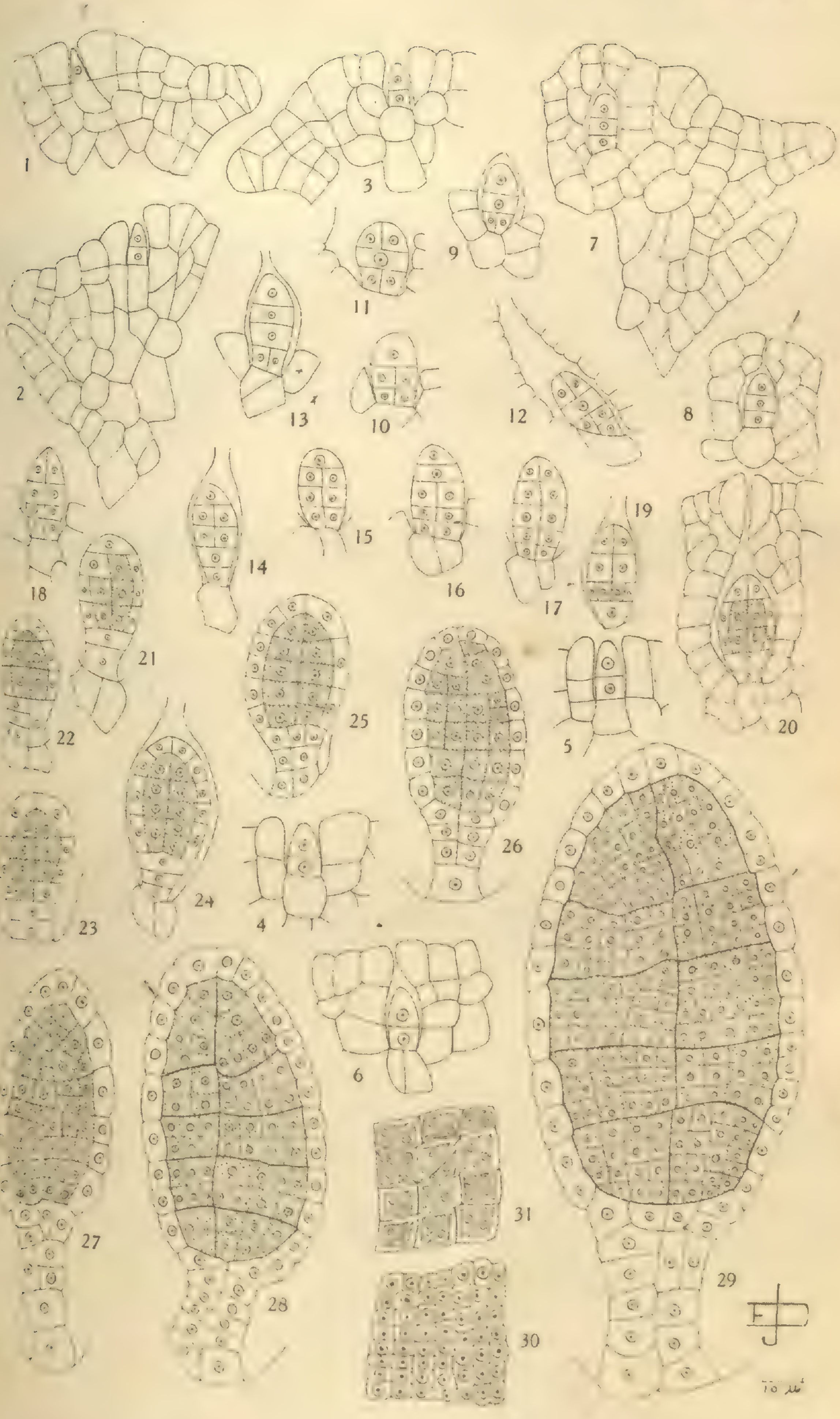
Hemsley, W. B. *Puya violacea.* Curt. Bot. Mag. **4**: *pl. 8194.* My 1908.

House, H. D. The genus *Shortia.* Torreya **7**: 233–235. 16 Ja 1908.

House, H. D. The North American species of the genus *Ipomoea.* Ann. N. Y. Acad. Sci. **18**: 181–263. 11 My 1908.

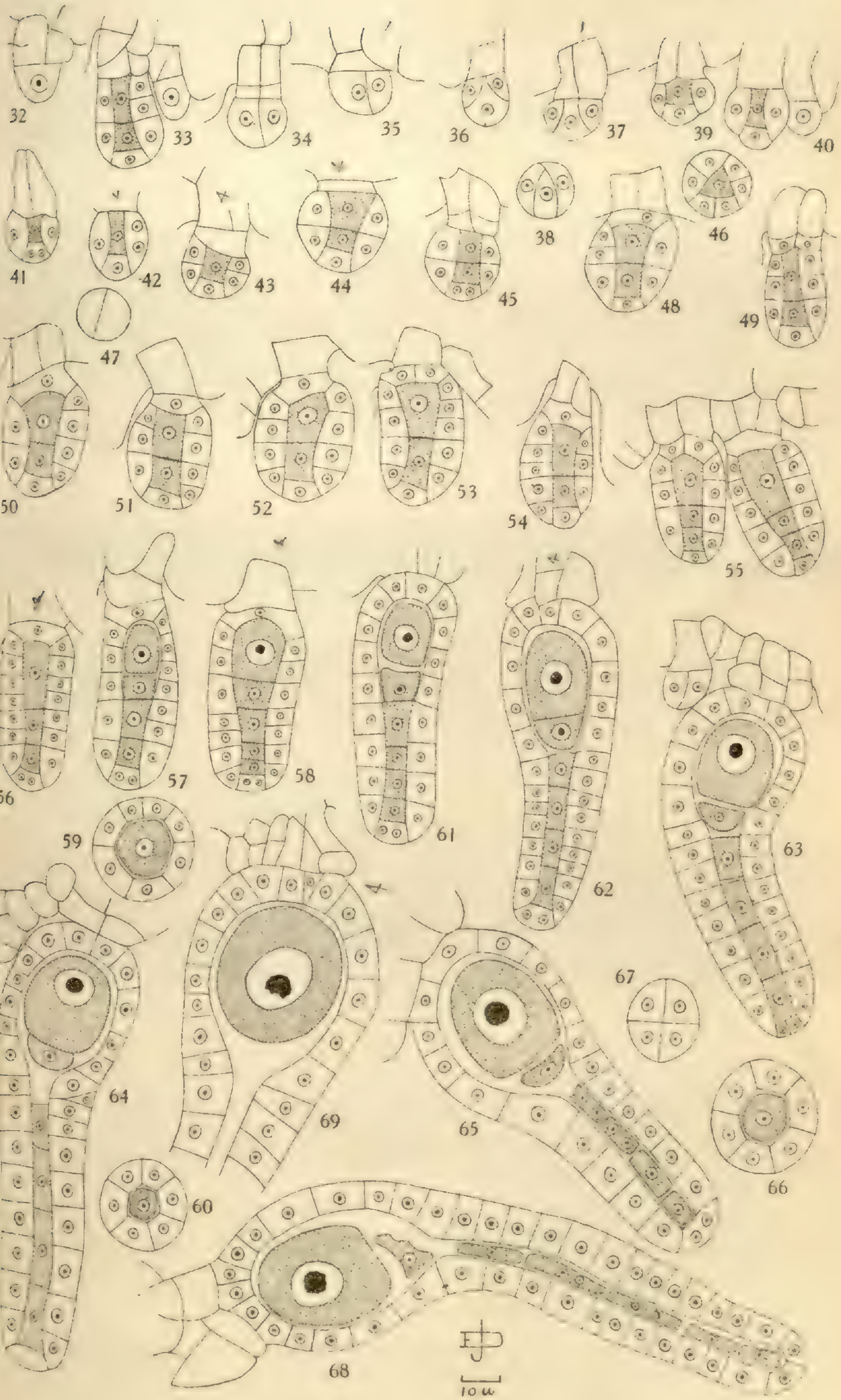
Hoyt, W. D. Periodicity in the fruiting of a marine alga. Plant World **11**: 102–106. *f. 4.* My 1908.

Jepson, W. L. The Washington palms. Muhlenbergia **4**: 41. 3 Je 1908.



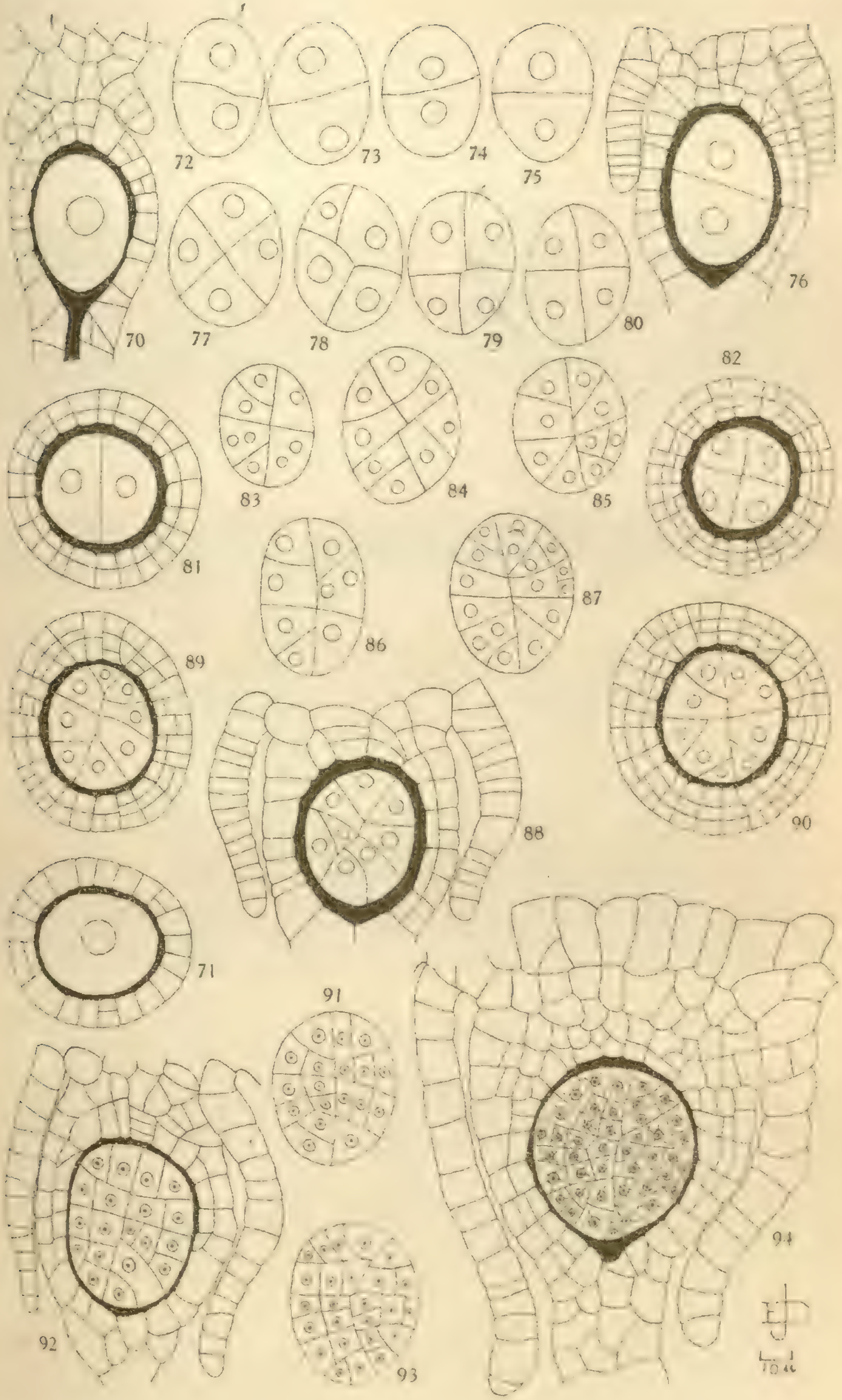
DURAND, MARCHANTIA POLYMORPHA

COCKAYNE, BOSTON



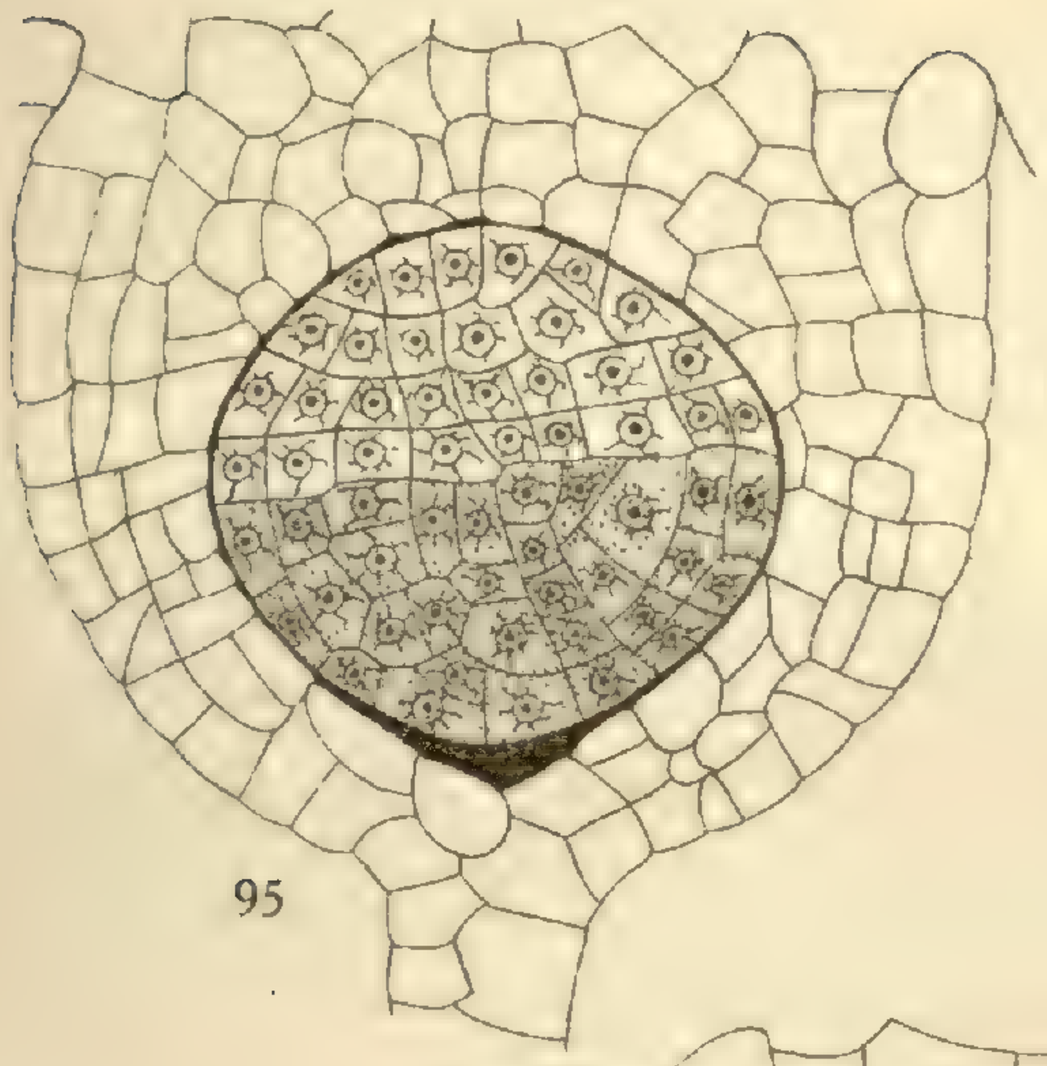
DURAND, MARCHANTIA POLYMORPHA

COCKAYNE, BOSTON

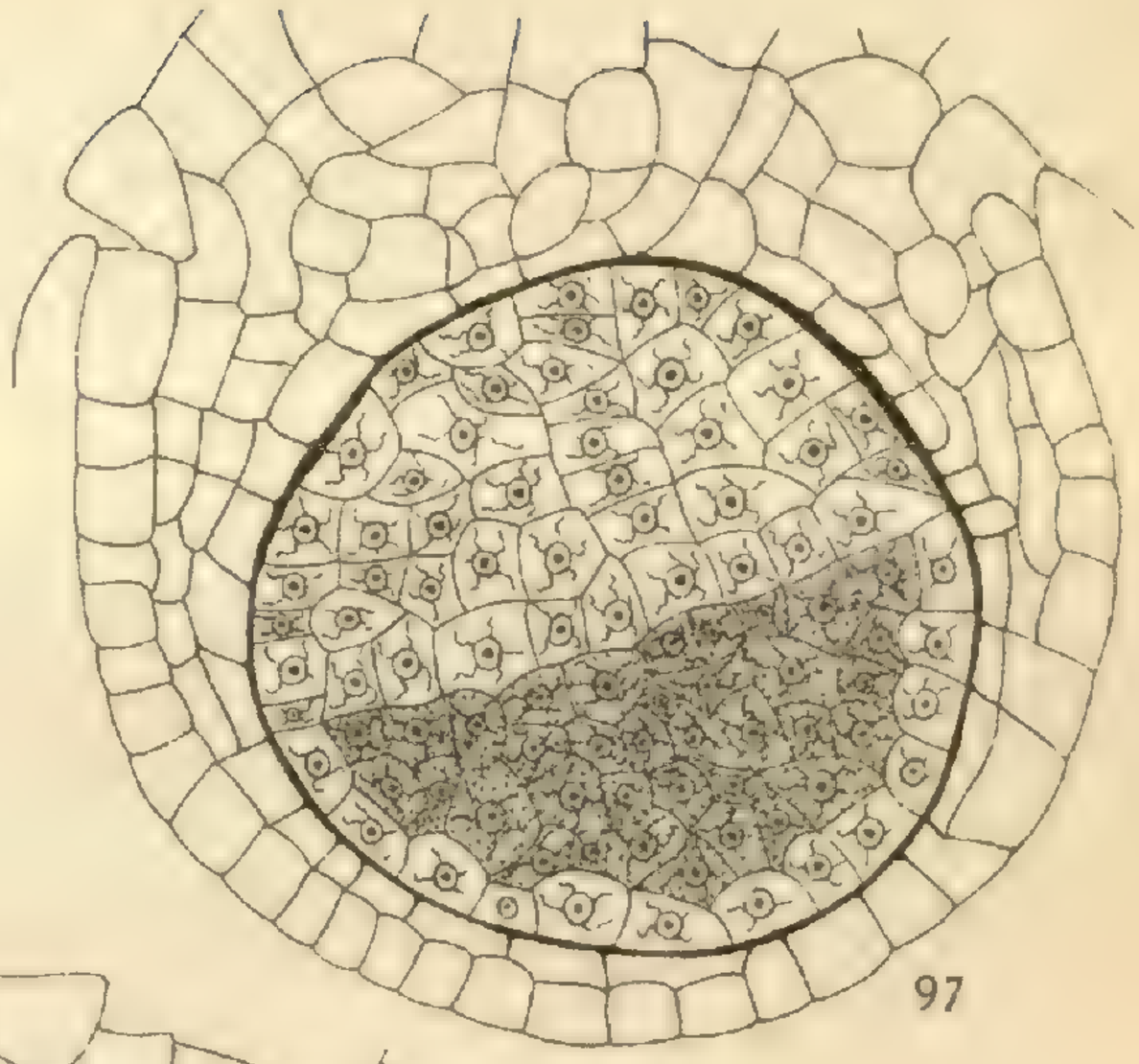


DURAND, MARCHANTIA POLYMORPHA

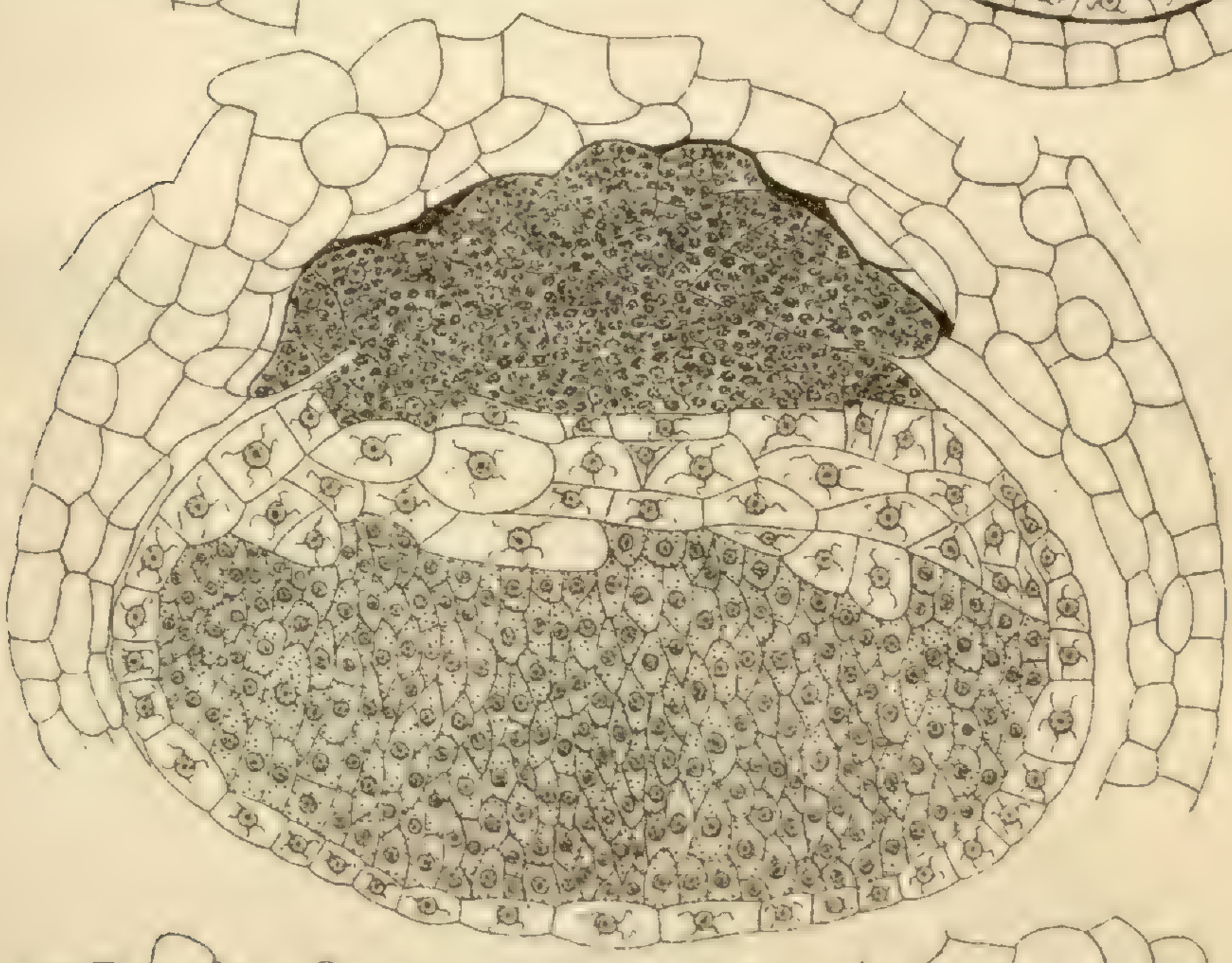
COCKAYNE, BOSTON



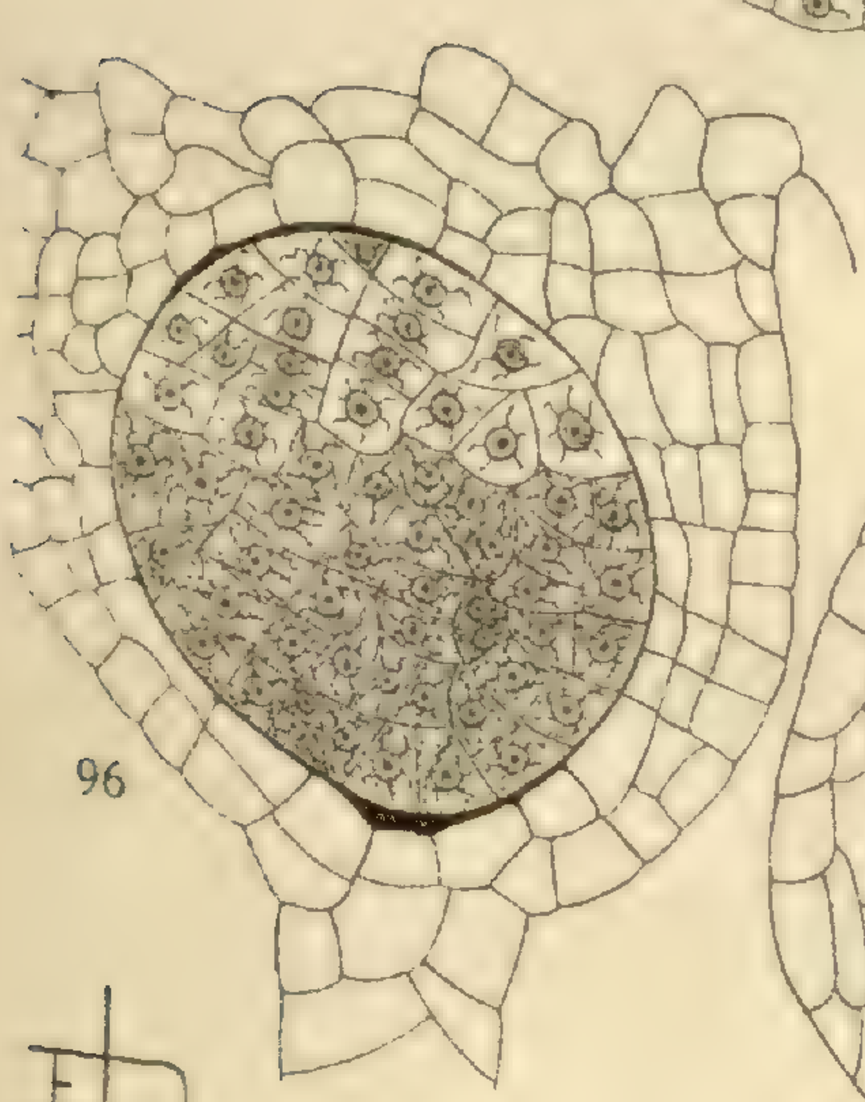
95



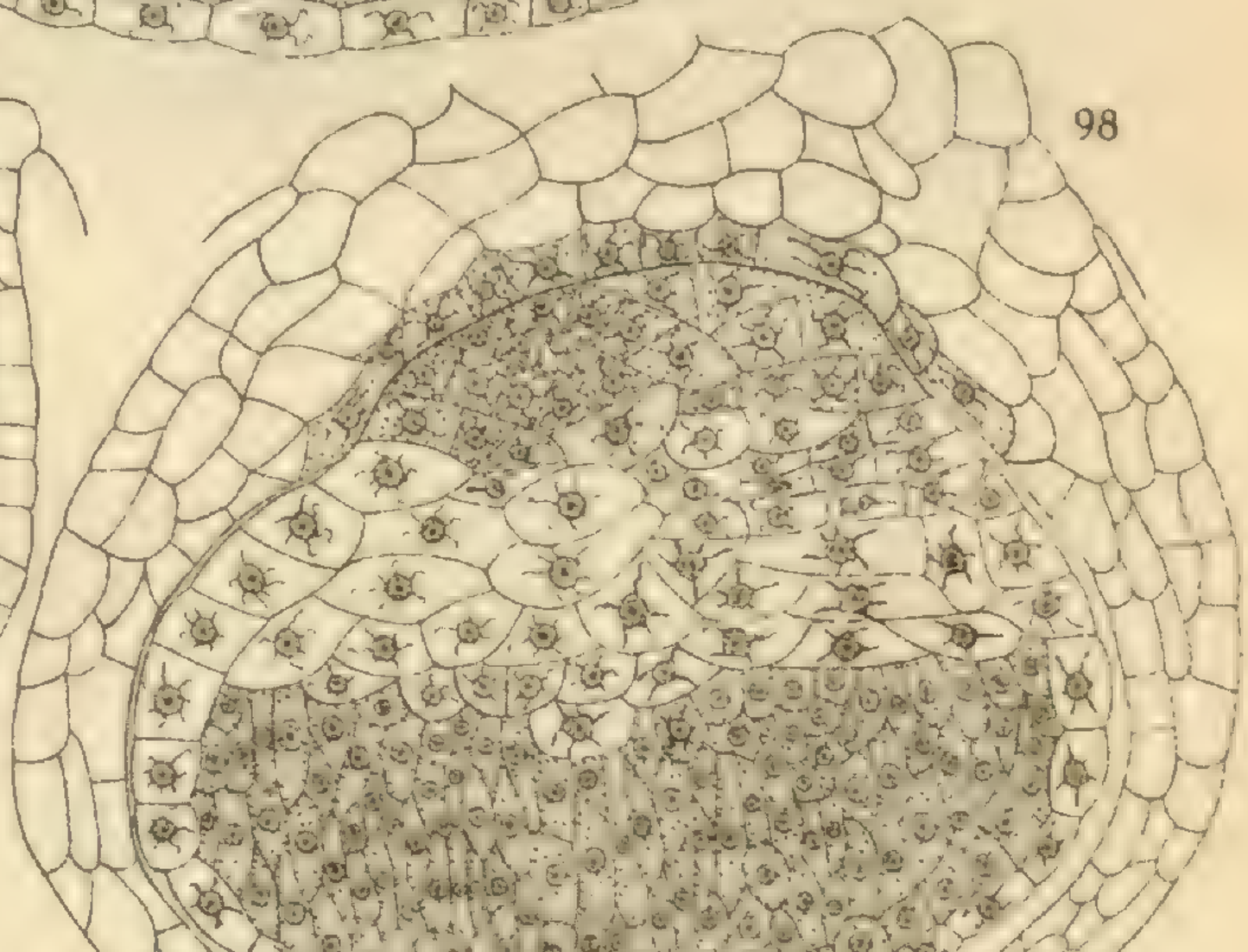
97



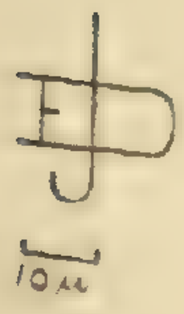
99



96

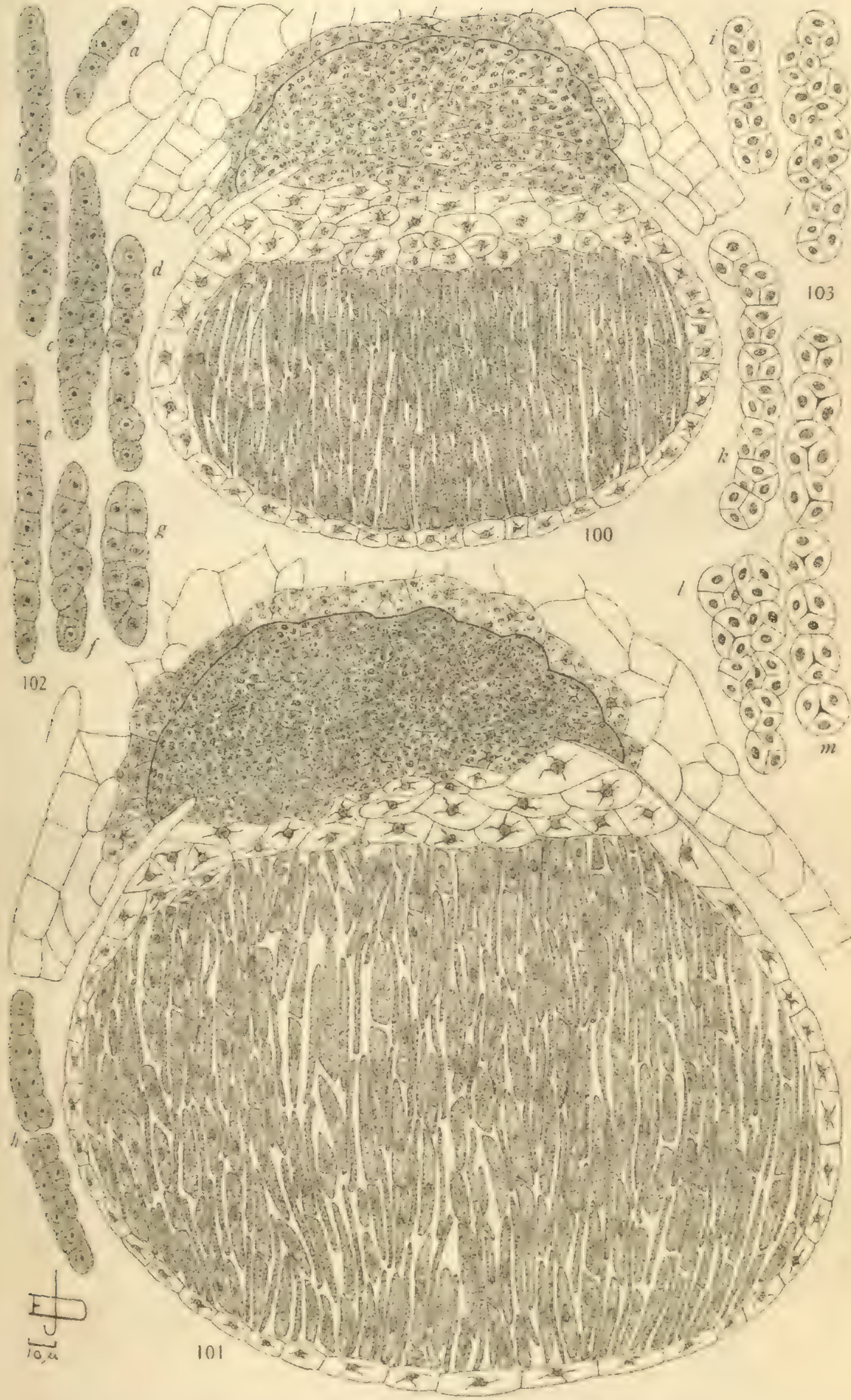


98



DURAND, MARCHANTIA POLYMORPHA

COCKAYNE, BOSTON



DURAND, MARCHANTIA POLYMORPHA

COCKAYNE, BOSTON

THE BRYOLOGIST

WITH THE JANUARY, 1908, NUMBER BEGINS ITS

ELEVENTH YEAR AND VOLUME

It is a 16–20 page bi-monthly devoted to the study of the Mosses, Hepatics, and Lichens. It is fully illustrated with new, original, and artistic drawings and half-tones. It is indispensable to the working bryologist, professional as well as amateur. Send for sample copy. Subscription price $1.00 a year.

Address, MRS. ANNIE MORRILL SMITH, 78 Orange Street, Brooklyn, N. Y.

INDEX TO AMERICAN BOTANICAL LITERATURE

This Index, printed each month in the BULLETIN, is reissued on library catalogue cards; these are furnished to subscribers at the rate of one cent for each card.

Subscriptions to the card-issue may be addressed to the Treasurer of the Torrey Botanical Club,

WILLIAM MANSFIELD, COLLEGE OF PHARMACY, 115 W. 68th St., N. Y. City.

Beginning with January, 1903, the Index has also been reprinted on paper, on one side only, and can be furnished in that form at the rate of $3.00 a year.

North American Flora

THIS work is designed to present descriptions of all plants growing independent of cultivation, in North America, here taken to include Greenland, Central America, the Republic of Panama, and the West Indies, except Trinidad, Tobago, and Curaçao and other islands off the north coast of Venezuela, whose flora is essentially South American.

It will be published in parts at irregular intervals by the New York Botanical Garden through the aid of the income of the David Lydig Fund bequeathed by Charles P. Daly.

It is planned to issue parts as rapidly as they can be prepared, the extent of the work making it possible to commence publication at any number of points. The completed work will form a series of volumes with the following sequence:

Volume 1. Mycetozoa, Schizophyta, Diatomaceae.
Volumes 2 to 10. Fungi.
Volumes 11 to 13. Algae.
Volumes 14 and 15. Bryophyta.
Volume 16. Pteridophyta and Gymnospermae.
Volumes 17 to 19. Monocotyledones.
Volumes 20 to 30. Dicotyledones.

The preparation of the work has been referred by the Scientific Directors of the Garden to a committee consisting of Professors L. M. Underwood and N. L. Britton.

Professor George F. Atkinson of Cornell University, Professors Charles R. Barnes and John M. Coulter of the University of Chicago, Mr. Frederick V. Coville of the United States Department of Agriculture, Professor Edward L. Greene of the United States National Museum, Professor Byron D. Halsted of Rutgers College and Professor William Trelease of the Missouri Botanical Garden have consented to act as an advisory committee.

The subscription price is fixed at $1.50 for each part; it is expected that four or five parts will be required for each volume. A limited number of separate parts will b sold at $2.00 each. Address,

THE NEW YORK BOTANICAL GARDEN
BRONX PARK, NEW YORK CITY

Vol. 7. Part 1, Ustilaginales, including Ustilaginaceae and Tilletiaceae, by G. P. Clinton, was issued Oct. 4, 1906. Vol. 7, Part 2, Coleosporiaceae, Uredinaceae and Aecidiaceae (pars), of the Uredinales, by J. C. Arthur was issued March 6, 1907. Vol. 22, Part 1, including Podostemonaceae by George V. Nash, Crassulaceae by N. L. Britton and J. N. Rose, and Penthoraceae and Parnassiaceae by P. A. Rydberg, was issued May 22, 1905. Vol. 22, Part 2, including Saxifragaceae and Hydrangeaceae by J. K. Small and P. A. Rydberg, Cunoniaceae, Iteaceae, and Hamamelidaceae by N. L. Britton, Pterostemonaceae by J. K. Small, Altingiaceae by Percy Wilson and Phyllonomaceae by H. H. Rusby, was issued Dec. 18, 1905. Vol. 25, Part 1, including Geraniaceae, by L. T. Hanks and J. K. Small, Oxalidaceae and Linaceae by J. K. Small, and Erythroxylaceae by N. L. Britton, was issued Aug. 24, 1907. Vol. 9, Part 1, Polyporaceae (pars), by W. A. Murrill, was issued Dec. 19, 1907.

PUBLICATIONS BY OFFICERS AND STUDENTS OF THE DEPARTMENT OF BOTANY, COLUMBIA UNIVERSITY

1. MEMOIRS OF THE DEPARTMENT:

Vol. 1. A Monograph of the North American Species of the Genus *Polygonum* (1895). By John Kunkel Small, Fellow in Botany, 1893–1895; Curator of the Herbarium, 1895–1898.

Quarto, 178 pages, 84 plates. Price $6.00.

Vol. 2. A Monograph of the North American Potentilleae (1898). By Per Axel Rydberg, Fellow in Botany, 1896–7.

Quarto, 224 pages, 112 plates. Price $6.00.

2. CONTRIBUTIONS FROM THE DEPARTMENT:

Vol. 1. Nos. 1–25. 1886–1892. Price $5.00.
Vol. 2. Nos. 26–50. 1892–1894. Price $5.00.
Vol. 3. Nos. 51–75. 1894–1895. Price $5.00.
Vol. 4. Nos. 76–100. 1895–1896. Price $5.00.
Vol. 5. Nos. 101–125. 1896–1897. Price $5.00.
Vol. 6. Nos. 126–150. 1897–1898. Price $5.00.
Vol. 7. Nos. 151–175. 1898–1901. Price $5.00.
Vol. 8. Nos. 176–200. 1901–1902. Price $5.00.
Vol. 9. Nos. 201–. 1903–(current).

List of separate numbers available on application.

3. A Text-book of General Lichenology (1896). By Albert Schneider, Fellow in Botany, 1895–1896.

Octavo, 230 pages, 76 plates. Price $4.25 (cloth); $3.80 (paper). Published by Willard N. Clute & Co. Binghamton, N. Y.

The Department invites propositions relative to exchanges of herbarium material for any of the above named publications. Address Dr. Carlton C. Curtis, Columbia University, N. Y. City.

4. An Illustrated Flora of the Northern United States, Canada, and the British Possessions from Newfoundland to the Parallel of the Southern Boundary of Virginia, and from the Atlantic Ocean westward to the 102d Meridian (1896–1898). By Nathaniel Lord Britton, Professor of Botany, 1891–1896; Emeritus Professor 1896–, and Hon. Addison Brown.

Three volumes, royal octavo. Vol. 1, 612 pages; Vol. 2, 642 pages; Vol. 3, 588 pages; 4162 figures in the text, illustrating every species described.

Published by Charles Scribner's Sons, New York. Price, in cloth, $9.00 for the three volumes; with the indexes and keys bound separately, $10.00.

5. Our Native Ferns and their Allies. (Sixth Edition) 1900. By Lucien Marcus Underwood, Professor of Botany, 1896–1907.

Duodecimo, 158 pages, 35 figures. Published by Henry Holt & Co., New York. Price, $1.00.

6. Moulds, Mildews, and Mushrooms. By Lucien Marcus Underwood, Professor of Botany, 1896–1907.

Duodecimo, 236 pages, 10 plates. Published by Henry Holt & Co. Price $1.50.

7. Nature and Development of Plants (1907). By Carlton Clarence Curtis, Assistant in Botany, 1892–1895; Tutor in Botany, 1895–1906; Instructor in Botany, 1906–.

Octavo, 471 pages; 342 illustrations. Published by Henry Holt & Co., New York. Price $2.50.

ESTABLISHED 1851

EIMER & AMEND

205–211 Third Ave.,
Corner 18th Street

NEW YORK

MANUFACTURERS AND IMPORTERS OF

Chemicals and Chemical Apparatus

Our Specialties

MICROSCOPES
and
ACCESSORIES

MICROTOMES

BALANCES
and
WEIGHTS

Sole Agents for

C. A. F.
KAHLBAUM'S
C. P. Chemicals
and Reagents

CARL
SCHLEICHER
& SCHÜLL'S
C. P. Filters

SCHOTT &
GENOSSEN'S
Famous Laboratory Glassware

And for many other renowned European houses in our line.

COMPLETE LINE OF

Bacteriological Apparatus

WE HANDLE

EVERYTHING NEEDED FOR A LABORATORY

Inspection of premises cordially invited.

MEMOIRS OF THE TORREY BOTANICAL CLUB

A series of technical papers on botanical subjects, published at irregular intervals. Price $3.00 a volume. Not offered in exchange.

Vol. 1, No. 1; not furnished separately:

Bailey, **Liberty Hyde.** Studies of the types of various species of the genus *Carex*. Pages 1–85. 25 My 1889.

Vol. 1, No. 2; not furnished separately:

Martindale, **Isaac Comly.** Marine algae of the New Jersey coast and adjacent waters of Staten Island. Pages 87–111. 24 Au 1889.

Vol. 1, No. 3; price, 75 cents:

Spruce, **Richard.** *Hepaticae* Bolivianae, in Andibus Boliviae orientalis, annis 1885–6, a cl. H. H. Rusby lectae. Pages 113–140. 20 Ja 1890.

Vol. 1, No. 4; price, 75 cents:

Sturtevant, **Edward Lewis.** On seedless fruits. Pages 141–187. 30 My 1890.

Vol. 2, No. 1; not furnished separately:

Halsted, **Byron David.** Reserve food-materials in buds and surrounding parts. Pages 1–26, *plates 1, 2*. 10 S 1890.

Vol. 2, No. 2; price, 75 cents:

Vail, **Anna Murray, & Hollick, Charles Arthur.** Contributions to the botany of Virginia. Pages 27–56, *plates 3, 4*. 23 D 1890.

Vol. 2, No. 3; not furnished separately:

Holm, **Herman Theodor.** Contributions to the knowledge of the germination of some North American plants. Pages 57–108, *plates 5–19*. 15 Ap 1891.

Vol. 2, No. 4; price, 75 cents:

Wheelock, **William Efner.** The genus *Polygala* in North America. Pages 109–152. 30 D 1891.

Vol. 3, No 1; not furnished separately:

Small, **John Kunkel, & Heller, Amos Arthur.** Flora of western North Carolina and contiguous territory. Pages 1–39. 20 F 1892.

Vol 3, No. 2; price, $2.00:

Morong, **Thomas.** The *Naiadaceae* of North America [with illustrations of all the species]. Pages 1–65, *plates 20–74*. 15 Mr 1893.

Vol. 3, No. 3; not furnished separately:

Rusby, **Henry Hurd.** An enumeration of the plants collected in Bolivia by Miguel Bang. [Part 1.] Pages 1–67. 28 Ap 1893.

Vol. 4, No. 1; not furnished separately:

Underwood, **Lucien Marcus.** Index *Hepaticarum*. Part I, Bibliography. Pages 1–91. 10 Je 1893.

Vol. 4, No. 2; not furnished separately:

Small, **John Kunkel, & Vail, Anna Murray.** Report on the botanical exploration of southwestern Virginia during the season of 1892. Pages 93–201, *plates 75–82*. 18 N 1893–17 Ap 1894.

Vol. 4, No. 3; price, 50 cents:

Rusby, **Henry Hurd.** An enumeration of the plants collected in Bolivia by Miguel Bang. Part 2. Pages 203–274. 10 Mr–17 Ap 1895.

Vol. 4, No. 4; price, 50 cents:

Pettit, **Anna Stockton.** *Arachis hypogaea* L. Pages 275–296, *plates 83–85* 5 Je 1895.

Vol. 4, No. 5; price, 75 cents:

Rydberg, **Per Axel.** The North American species of *Physalis* and related genera. Pages 297–374. 15 S 1896.

Vol. 5; price, $3.00:

List of *Pteridophyta* and *Spermatophyta* growing without cultivation in northeastern North America. Pages 1–377. 4 D 1893–31 D 1894.

Vol. 6, No. 1; price, $1.25:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 3. Pages 1–130. 17 N 1896.

Vol. 6, No. 2; not furnished separately:

Grout, Abel Joel. A revision of the North American *Isotheciaceae* and *Brachytheciz.* Pages 131–210. 30 Jl 1897.

Vol. 6, No. 3; price, 50 cents:

Hazen, Tracy Elliot. The life history of *Sphaerella lacustris* (*Haematococcus pluvialis*). Pages 211–246, *plates 86, 87* (*colored*). 8 Je 1899.

Vol. 6, No. 4; price, 50 cents:

Underwood, Lucien Marcus. A review of the genera of ferns proposed prior to 1832. Pages 247–283. 1 D 1899.

Vol. 6, No. 5; price, 25 cents:

Fink, Bruce. Notes on lichen distribution in the upper Mississippi Valley. Pages 285–307. 1 D 1899.

Vol. 7; price, $3.00:

Howe, Marshall Avery. The *Hepaticae* and *Anthocerotes* of California. Pages 1–208, *plates 88–122*. 5 Au 1899.

Vol. 8, No. 1; not furnished separately:

Lloyd, Francis Ernest. The comparative embryology of the *Rubiaceae*. Part I. Pages 1–26, *plates 1–4*. 26 Au 1899. Part II. Pages 27–112, *plates 5–15*. 15 F 1902.

Vol. 8, No. 2; price, $1.00:

Evans, Alexander William. The *Lejeuneae* of the United States and Canada. Pages 113–183, *plates 16–22*. 15 F 1902.

Vol. 8, No. 3; price, 75 cents:

Britton, Elizabeth Gertrude, & Taylor, Alexandrina. The life history of *Vittaria lineata*. Pages 185–211, *plates 23–31*. 30 Au 1902.

Vol. 9; price, $3.00:

Salmon, Ernest Stanley. A monograph of the *Erysiphaceae*. Pages 1–292, *plates 1–9*. 4 O 1900.

Vol. 10; price, $3.00:

Burgess, Edward Sandford. History of Pre-Clusian botany in its relation to *Aster*. Pages i–xii, 1–447. 22 N 1902.

Vol. 11, No. 1; price, $1.75:

Griffiths, David. The North American *Sordariaceae*. Pages 1–134, *plates 1–19*. 30 My 1901.

Vol. 11, No. 2; price, $1.75:

Hazen, Tracy Elliot. The *Ulothricaceae* and *Chaetophoraceae* of the United States. Pages 135–250, *plates 20–42*. 20 O 1902.

Vol. 12, No. 1; price, $1.50:

Northrop, Alice Rich. Flora of New Providence and Andros (Bahama Islands). Pages 1–98, *plates 1–19 + map*. 10 D 1902.

Vol. 12, No. 2; price, $1.00:

Banker, Howard James. A contribution to a revision of the North American *Hydnaceae*. Pages 99–194. 13 Je 1906.

Vol. 12, No. 3; price, 75 cents:

Kupfer, Elsie. Studies in plant regeneration. Pages 195–241. 10 Je 1907.

Vol. 13; price, $3.00:

Burgess, Edward Sandford. Species and variations of Biotian Asters, with discussion of variability in *Aster*. Pages i–xv, 1–419, *plates 1–13*. 15 Mr 1906.

Vol. 14, No. 1; price, $1.25:

Burlingham, Gertrude Simmons. A study of the *Lactariae* of the United States. Pages 1–109, *figures 1–15*. 26 My 1908.

Address: **TORREY BOTANICAL CLUB,**
Columbia University, New York City.

VOL. 35 AUGUST, 1908 NO. 8

BULLETIN

OF THE

TORREY BOTANICAL CLUB

Editor

MARSHALL AVERY HOWE

Associate Editors

JOHN HENDLEY BARNHART
JEAN BROADHURST
PHILIP DOWELL
ALEXANDER WILLIAM EVANS
TRACY ELLIOT HAZEN
WILLIAM ALPHONSO MURRILL
CHARLES LOUIS POLLARD
HERBERT MAULE RICHARDS

CONTENTS

New West Indian Lejeuneae. (Plates 26–28.)
ALEXANDER WILLIAM EVANS 371
Additional Philippine Polyporaceae . . . WILLIAM ALPHONSO MURRILL 391
INDEX TO AMERICAN BOTANICAL LITERATURE. 417

PUBLISHED FOR THE CLUB

THE NEW ERA PRINTING COMPANY
LANCASTER, PA.

THE TORREY BOTANICAL CLUB

President,

HENRY H. RUSBY, M.D.

Vice-Presidents,

EDWARD S. BURGESS, PH.D. JOHN HENDLEY BARNHART, A.M., M.D.

Recording Secretary,

C. STUART GAGER, PH.D.

Botanical Garden, Bronx Park, New York City.

Treasurer,

WILLIAM MANSFIELD, PHAR.D.

College of Pharmacy,
115 West 68th St., New York City.

MEETINGS

Meetings twice each month from October to May inclusive: the second Tuesday, at 8:00 P.M., at the American Museum of Natural History; the last Wednesday, at 3:30 P.M., in the Museum Building of the New York Botanical Garden.

PUBLICATIONS

All subscriptions and other business communications relating to the publications of the Club should be addressed to the Treasurer, William Mansfield, College of Pharmacy, 115 West 68th St., New York City.

Bulletin. Monthly, established 1870. Price, $3.00 a year; single numbers 30 cents. Of former volumes, only 24–34 can be supplied separately; certain numbers of other volumes are available, but the entire stock of some numbers has been reserved for the completion of sets. Manuscripts intended for publication in the BULLETIN should be addressed to Marshall A. Howe, Editor, New York Botanical Garden, Bronx Park, New York City.

Torreya. Monthly, established 1901. Price, $1.00 a year. Manuscripts intended for publication in TORREYA should be addressed to Jean Broadhurst, Editor, Teachers College, Columbia University, New York City.

Memoirs. Occasional, established 1889. (See last pages of cover.)

Preliminary Catalogue of Anthophyta and Pteridophyta within 100 miles of New York City, 1888. Price, $1.00.

Vol. 35 No 8

BULLETIN

OF THE

TORREY BOTANICAL CLUB

AUGUST, 1908

New West Indian Lejeuneae

ALEXANDER WILLIAM EVANS

(WITH PLATES 26–28)

Students of the Hepaticae cannot help being impressed by the remarkable development of the *Lejeuneae* in tropical regions. Usually more than half of the species in any particular locality belong to this group, and many of the species are represented by numerous individuals. The *Lejeuneae* have become adapted to a great variety of external conditions. Some are true xerophytes and are able to endure desiccation for considerable periods; others cannot exist except in the constant shade of moist forests. Some grow on rocks or on the bark of trees, others are found only on living leaves, while still others carry on their entire development within the tufts of larger bryophytes. In all probability the group is essentially modern, and the species have acquired their great diversity of form and their manifold adaptations to peculiar modes of life within comparatively recent times.

The West Indies agree with other tropical regions in showing a large preponderance of *Lejeuneae*. In a series of papers on the Hepaticae of Puerto Rico * the writer has recently had occasion to describe and figure more than fifty species in the group, many of which have a geographical range extending far beyond the limits of this particular island. In connection with the specific descriptions the genera to which the species are referred are also discussed, and in several instances it has seemed advisable to propose new genera or to emend the characters of accepted genera as given by earlier writers. In the course of this study other West

* Bull. Torrey Club **29–35.** 1902–1908.

[The BULLETIN for July, 1908 (35 : 321–370. *pl. 21–25*) was issued 30 Jl 1908.]

Indian *Lejeuneae*, not yet known from Puerto Rico and apparently new, have been distinguished, and six of these are described and figured in the present paper. One local species from the Blue Mountains of Jamaica is made the type of a new genus; the others belong to genera which have been discussed in connection with the Puerto Rico flora, and the reader is therefore referred to the series noted above for an account of the generic peculiarities. The type specimens of the new species are preserved in the herbarium of the writer, at New Haven, Connecticut.

Trachylejeunea dilatata sp. nov.

Pale green, dull, scattered or forming thin depressed mats: stems 0.085 mm. in diameter, loosely adherent to the substratum, copiously and irregularly pinnate, the branches widely spreading, simple or sparingly subdivided, often with smaller leaves than the stem but not microphyllous: leaves contiguous to loosely imbricated, the lobe strongly falcate, obliquely spreading, convex, abruptly dilated from a narrow base, orbicular-obovate in general outline, 0.35–0.5 mm. long, antical margin decurrent by a single cell, straight or slightly incurved near the base, then strongly outwardly curved to apex, postical margin also outwardly curved, apex broad and rounded, rarely very bluntly pointed, margin denticulate from projecting cells except close to antical base; lobule inflated throughout, abruptly contracted in the outer part to a circular opening, ovate, 0.17 mm. long, 0.14 mm. wide, keel strongly arched, forming an angle of about 90° with postical margin of lobe, free margin curved and entire, revolute, meeting surface of lobe at about a right angle, apical tooth consisting of a slightly projecting cell, short and blunt, bearing the hyaline papilla in a slight depression on the proximal side, sinus straight or lunulate, forming with the apical tooth the greater part of the opening into the water-sac; cells of lobe averaging 15 μ at the margin and 35 × 21 μ in the middle and at the base, postical surface plane or nearly so, antical surface varying from plane to convex and conical in passing from basal and median regions toward the margin, walls thin throughout or with very minute triangular trigones; ocelli none: underleaves distant, plane, orbicular, 0.12 mm. long, bifid to about the middle with erect, acute to obtuse divisions, mostly three or four cells long and three or four cells wide at the base, sinus obtuse, margin entire or subdenticulate from projecting cells, sometimes unidentate on sides, basal region cuneate: inflorescence autoicous: ♀ inflorescence sometimes borne on a leading branch, sometimes on a more or less abbreviated branch, innovating on one, rarely on both sides,

the innovations sterile or rarely again floriferous; bracts obliquely spreading, complicate, keel sharp but not winged, lobe oblong to obovate, 0.75 mm. long, 0.45–0.55 mm. wide, margin as in the leaves, lobule ovate-lanceolate, obtuse, 0.4 mm. long, 0.17 mm. wide, margin entire or nearly so; bracteole very slightly connate on both sides, oblong, 0.4 mm. long, 0.35 mm. wide, bifid about one third with erect obtuse lobes, and an obtuse or subacute sinus, margin vaguely and irregularly crenulate from projecting cells; perianth slightly exserted, ovoid, 0.6 mm. long, 0.35 mm. wide, cuneate toward base, truncate or retuse at apex with a short beak crenulate at the mouth, slightly compressed, sharply five-keeled in upper part, each keel bearing two denticulate wings, one or rarely two to five cells wide, surface otherwise smooth or nearly so: ♂ inflorescence occupying a short branch or terminal on a more or less elongated branch, not proliferating; bracts mostly in two to fifteen pairs, loosely imbricated, much smaller than the leaves, strongly inflated, slightly and subequally bifid, the lobes rounded and crenulate at the apex, keel strongly arched, crenulate; antheridia in pairs: capsule about 0.2 mm. in diameter; spores irregular in form, about 12 μ in short diameter, greenish, minutely verruculose. (PLATE 26, FIGURES 1–13.)

On leaves of ferns. Jamaica: Mabess River, *Maxon* (*1544*), *Evans* (*311*). Dominica: Laudat Mountain, *Lloyd* (*102*). The specimens collected by the writer may be considered the type.

Except for the delicate texture of the plants and the roughness of the leaf-lobes, the present species might be placed in the genus *Crossotolejeunea*. In fact *Trachylejeunea* and *Crossotolejeunea* have so many characters in common that the line of demarcation between them is largely artificial. The roughness in *T. dilatata* is restricted to the outer or antical surface of the lobe and to the keels of the perianth, the surface of the lobule and of the perianth between the keels being smooth. Even in the lobes the basal and median regions are smooth and the roughness is sometimes confined to a very narrow border. It is not produced by a wart-like thickening of the walls as in certain other members of the genus but is due to the fact that each cell is strongly convex or conical. Usually the walls are thin throughout, but occasionally minute trigones and very slight thickenings at the apices of the conical cells may be demonstrated. The great disparity in size between the median and marginal cells is a striking feature of the plant. The abrupt dilation of the lobe, the marginal denticulations, and the

small underleaves are characters which *T. dilatata* shares with certain species of *Prionolejeunea*, but of course its five-keeled perianth would at once exclude it from this genus.

Of the three species of *Trachylejeunea* already recorded from the West Indies, *T. prionocalyx* (Gottsche) Schiffn.* is especially close to *T. dilatata*. This species is apparently endemic to Cuba. The original material was collected by Wright, but additional specimens were lately found by Underwood and Earle on El Yunque Mountain, near Baracoa. Both species show an abrupt dilation of the lobe, thin cell-walls, an absence of ocelli, an autoicous inflorescence, and subfloral innovations. In *T. prionocalyx*, however, the plants are smaller than in *T. dilatata*, the leaves rarely exceeding 0.3 mm. in length, the margins of the lobes are crenulate rather than denticulate, and the roughness is restricted to the keels of the perianth, even the leaf-lobes being smooth except for the marginal crenulations. Here again the roughness of the keels is due to projecting cells, but these are longer than in *T. dilatata*, their walls are thicker, and their extremities are rounded rather than conical; the effect produced is one of greater roughness. The male spikes in *T. prionocalyx* are short and show only two or three pairs of bracts.

The two other West Indian species of *Trachylejeunea* are *T. Aquarius* (Spruce) Evans † and *T. Spruceana* Steph.‡ The first of these was originally described from Brazilian material but is now known also from both Puerto Rico and Cuba; the second is known only from Guadeloupe, where the type specimens were collected by L'Herminier. In *T. Aquarius* the plants are more robust than in *T. dilatata*, the leaves are ocellate at the base, the leaf-cells have large and conspicuous trigones, and the roughness affects not only the lobes and lobules but also the surface of the perianth between the keels, especially in the upper part. In the perianth the roughness is due to convex and uniformly thickened cell-walls, while in the leaves there is a large median wart arising from each cell. Even the underleaves in this species sometimes show a few scattered warts along the margin. In *T. Spruceana*

* Bot. Jahrb. **23**: 592. *pl. 15. f. 8–12.* 1897.

† Hep. Amaz. et And. 185. 1884. See also Evans, Bull. Torrey Club **30**: 561. *pl. 22. f. 11–22.* 1903.

‡ Hedwigia **35**: 138. 1896.

the trigones are also large and the underleaves are everywhere denticulate. The species is dioicous and is described from male material; in the absence of perianths its generic position cannot be regarded as definitely established.

Another species which should also be compared with *T. dilatata* is the dioicous *Lejeunea asperrima* Spruce. Unfortunately the generic position of this plant is far from settled, because the perianths are still unknown. In the original description Spruce referred it with some question to *Prionо-Lejeunea*;* he afterwards transferred it to *Harpalejeunea* † and still later distributed it in his Hepaticae Spruceanae under *Trachylejeunea*. *L. asperrima* was first described from Brazilian specimens but has since been reported by its author from the island of St. Vincent. In the abrupt dilation of its leaf-lobes, in its thin cell-walls, in its lack of ocelli and in its subfloral innovations, it agrees with both *T. dilatata* and *T. prionocalyx*. The roughness, however, is more extensive, a portion of the lobule and practically the whole of the lobe being involved. The leaf-cells are thin-walled throughout, and the roughness, as in *T. dilatata*, is due to the conical projections of the cells. The species is about as large as *T. prionocalyx*.

Harpalejeunea reflexula sp. nov.

Pale or bright green, dull, scattered among other *Lejeuneae* or forming small depressed mats: stems 0.35 mm. in diameter, loosely adherent to the substratum, sparingly and irregularly pinnate, the branches widely spreading, similar to the stem: leaves loosely imbricated, the lobe obliquely spreading, strongly convex and usually reflexed or revolute at the apex, falcate, broadly ovate, 0.25 mm. long, 0.2 mm. wide, antical margin decurrent by a single cell, nearly straight near base, then strongly outwardly curved to apex, postical margin straight or slightly curved, apex gradually acuminate, usually tipped with a row of from two to four cells, margin entire or vaguely and irregularly crenulate from projecting cells; lobule ovate in outline, 0.14 mm. long, 0.1 mm. wide, abruptly contracted in outer part, otherwise strongly inflated and forming an almost spherical water-sac, keel strongly arched, forming an angle of about 90° with postical margin of lobe, free margin curved and revolute to beyond the apex, tipped with a single blunt cell; cells of lobe slightly convex, averaging 12 μ at

* Hep. Amaz. et And. 160. 1884.
† Jour. Linn. Soc. Bot. 30: 341. 1894.

the margin and 14 × 12 μ in median and basal portions, trigones small and usually distinct but sometimes confluent, intermediate thickenings occasional and usually indistinct; ocelli commonly two at base of lobe, measuring about 28 × 18 μ, a few other cells with similar contents often scattered through the lobe but inconstant in number and position: underleaves distant, suborbicular from a cuneate base, 0.07 mm. long, bifid about one third with an obtuse sinus and broad, obliquely spreading lobes, each about four cells wide, three cells long and tipped with two cells side by side, margin entire or nearly so, radicelliferous disc sometimes present: inflorescence dioicous: ♀ inflorescence on a more or less elongated branch, innovating on one side, the innovation usually simple and sterile; bracts obliquely spreading (somewhat unequal in size, the one subtending the innovation smaller than the other), sharply complicate and unequally bifid, keel bearing a narrow and entire wing, lobe obovate, measuring (in larger bract) 0.4 mm. in length and 0.25 mm. in width, apex rounded to obtusely pointed, margin irregularly crenulate from projecting cells, lobule obovate, 0.35 mm. long, 0.2 mm. wide, mostly rounded at the apex, margin as in lobe; bracteole free or nearly so, obovate, 0.35 mm. long, 0.2 mm. wide, bifid about one fourth with rounded, obliquely spreading lobes and blunt sinus, margin minutely crenulate; perianth about one third exserted, obovoid, 0.6 mm. long, 0.35 mm. wide, truncate or slightly retuse at the apex with a short but distinct beak, sharply five-keeled in upper part, the keels not winged but vaguely and irregularly crenulate from projecting cells with thickened walls: ♂ inflorescence and mature sporophyte not seen. (PLATE 26, FIGURES 14–25.)

On bark of trees. Jamaica: John Crow Peak, *Evans* (88, 92). No. 88 may be designated the type.

Apparently the closest ally of *H. reflexula* is *H. uncinata* Steph.,* now known from Cuba, Santo Domingo, Puerto Rico, and Trinidad. The two species agree in size, in the form of the leaves and underleaves, and in the measurements of the leaf-cells. The bracts and perianths yield the best characters for separating them. In *H. uncinata* the margins of the lobes are distinctly toothed, and the keels of the perianth bear dentate to spinose wings, whereas in *H. reflexula* the margins of the bracts are scarcely more than crenulate, and the keels of the perianth, although sharp, are destitute of distinct wings. In the absence of floral organs the determina-

* Hedwigia 35: 97. 1897. See also Evans, Bull. Torrey Club 30: 549. *pl. 20. f. 12–24.* 1903.

tion is beset with greater difficulties. It should be noted, however, that the leaf-lobes in *H. uncinata* are less commonly reflexed than in the new species, that their apical acuminations are longer and more abrupt, that their margins are rather more distinctly crenulate, that the leaf-cells have less distinct trigones, and that the lobule, although strongly inflated, shows the free margin and apex clearly without dissection.

Two other related species are the Puerto Rico *H. subacuta* Evans* and *Lejeunea* (*Harpalejeunea*) *stricta* Lindenb. & Gottsche,† originally described from Mexican specimens but recently collected by the writer at Mabess River, Jamaica. In *H. subacuta* the lobes of the stem-leaves are rounded to subacute at the apex, in the latter case being usually tipped with a single cell; occasionally on the leaves of small branches there may be two superimposed cells at the apex, but this can hardly be regarded as a typical condition. In *L. stricta* the lobes of the leaves are a little sharper than in *H. subacuta* and often show two superimposed cells. In this species, however, the bracteole is scarcely retuse, and the keels of the perianth bear narrow, denticulate wings.

Leiolejeunea gen. nov.

Plants small, neither pigmented nor glossy: stems prostrate, sparingly branched: leaves contiguous to loosely imbricated, the lobe squarrose, convex, obliquely spreading, ovate, gradually narrowed toward apex; lobule ovate in outline, strongly inflated along keel, apical tooth unicellular, sharp, hyaline papilla distal and marginal, arising from the cell next the apical tooth; cells of lobe plane or slightly convex, with local thickenings of the walls: underleaves distant, broad at apex and showing two rounded divisions separated by a shallow sinus: ♀ branch without subfloral innovations; bracts much larger than the leaves, very unequally bifid, the lobule being small and sometimes obsolete; bracteole shortly bifid; perianth slightly compressed, obovoid, distinctly beaked, destitute of keels and smooth or nearly so on surface: ♂ inflorescence short, not proliferating; bracts monandrous, imbricated, shortly and subequally bifid with rounded divisions, strongly inflated; bracteoles similar to the underleaves, limited to base of spike. (Name from λεῖος, smooth, and *Lejeunea*, in allusion to the perianth without keels.)

* Bull. Torrey Club 30: 547. *pl. 20. f. 1–11.* 1903.
† G. L. & N. Syn. Hep. 756. 1847.

The underleaves of *Leiolejeunea* agree in all essential respects with those of *Harpalejeunea*, and this peculiarity will at once serve to distinguish the genus from all the other genera of the *Lejeuneae Schizostipae*. The leaf-lobes and leaf-cells are also much the same as in *Harpalejeunea*, but the differential characters derived from the lobules, bracts, and perianths are so striking that the two genera could hardly be united. In *Leiolejeunea* the apical tooth of the lobule forms a continuous line with the proximal portion of the free margin, while the hyaline papilla is distal in position and slightly displaced from the apical tooth; in *Harpalejeunea* the hyaline papilla is situated at the proximal base of the apical tooth in a slight indentation. In *Leiolejeunea* the lobes of the bracts are much larger than the lobules, the latter being reduced to small basal folds; in *Harpalejeunea* the lobules are always distinct and are only a little smaller than the lobes. In *Leiolejeunea* the perianth is practically smooth, the only indications of keels being five very vague and slight elevations in the apical region; in *Harpalejeunea* the perianth develops five sharp keels. The absence of true subfloral innovations in *Leiolejeunea* and their constant presence in *Harpalejeunea* should also be emphasized in distinguishing the genera.

In the majority of the *Lejeuneae* with bifid underleaves, the hyaline papilla of the lobule is proximal in position, agreeing in this respect with *Harpalejeunea*. Both *Euosmolejeunea* and *Cheilolejeunea*, however, show a distal papilla, which perhaps indicates some relationship with *Leiolejeunea*. In *Euosmolejeunea* the relatively large underleaves with pointed divisions and the sharply five-keeled perianth afford distinguishing peculiarities, while in *Cheilolejeunea* the divisions of the underleaves are also pointed and the strongly flattened perianth shows sharp lateral keels and a more or less distinct postical keel. The genus *Leiolejeunea* is at present monotypic, being based on the following species:

Leiolejeunea grandiflora sp. nov.

Dull, yellowish green, growing in depressed mats: stems 0.05 mm. in diameter, loosely adherent to the substratum, irregularly pinnate, the branches widely spreading, never microphyllous: leaves mostly more or less imbricated, the lobe falcate-ovate, 0.35 mm. long, 0.25 mm. wide, antical margin decurrent by a single

cell (as in *Harpalejeunea*), nearly straight near base, then strongly outwardly curved to apex, postical margin slightly curved, forming a shallow indentation at junction with keel, apex obtuse or rounded, margin entire or very vaguely crenulate from projecting cells; lobule 0.2 mm. long, 0.1 mm. wide, free margin revolute or appressed to lobe, sinus lunulate, forming together with the apical tooth the opening into the water-sac; cells of lobe averaging 16 μ at the margin, 20 × 16 μ in the middle, and 25 × 16 μ at the base, trigones large and distinct, triangular, intermediate thickenings occasional, oval or rotund, sometimes confluent; ocelli none: underleaves appressed, broadly obovate, 0.12 mm. long, 0.19 mm. wide, cuneate toward base, slightly retuse at the apex, thus forming the two rounded divisions, margin faintly crenulate from projecting cells: inflorescence dioicous: ♀ inflorescence borne on a more or less elongated branch; bracts widely spreading, the lobe abruptly dilated from a narrow base, falcate, the antical margin strongly curved and much longer than the postical, ovate, 0.95 mm. long, 0.75 mm. wide, abruptly acuminate, margin sparingly and irregularly dentate with rounded or obtuse teeth, lobule linear, obtusely pointed, 0.17 mm. long, 0.03 mm. wide, sometimes obsolete, keel rounded, not winged; bracteole slightly adnate at base on both sides, ovate to ligulate, 0.6 mm. long, 0.25 mm. wide, shortly bifid at the apex with a sharp sinus and erect obtuse or rounded divisions, margin more or less crenulate from projecting cells; perianth not projecting beyond bracts, 0.7 mm. long, 0.45 mm. wide, truncate or slightly retuse at the apex: ♂ inflorescence occupying a short branch or terminal on a longer branch: neck of fertilized archegonium usually projecting through beak of perianth: capsule about 0.25 mm. in diameter; spores irregular in form but mostly oblong, greenish, about 28 μ in short diameter, minutely verruculose on surface and also bearing scattered circular patches of minute radiating ridges. (PLATE 27, FIGURES 1–10.)

On bark of trees. Jamaica: Blue Mountain Peak, *Johnson (5, 6)*, *Evans (221 p. p.)*. No. 6 is the type specimen.

In the absence of floral organs *L. grandiflora* might easily be confused with some of the species of *Harpalejeunea* in which the leaves are blunter than is usual in this genus. Among West Indian species *H. subacuta* might be cited as an example. Of course the dissection of the lobule and the demonstration of the hyaline papilla would at once remove all doubt, but there are a few other differences which might also be noted in this connection. In *L. grandiflora* there is a more marked indentation at the junction of

the postical margin of the lobe and the keel than in *H. subacuta*, the trigones of the leaf-cells are more pronounced, and there are no basal ocelli. Even the underleaves, although built up on the same plan as in *H. subacuta*, are composed of a much larger number of cells, the divisions being often six cells long and five to seven cells wide at the base; in *H. subacuta* the divisions are usually only three cells long and four cells wide at the base.

Odontolejeunea longispica sp. nov.

Brownish or yellowish green, scattered or growing in loose, depressed mats, more or less mixed with other hepatics: stems 0.1 mm. in diameter, copiously and irregularly branched, the branches widely spreading, often soon floriferous: leaves contiguous or loosely imbricated, the lobe plane or a little convex, rarely narrowly revolute along postical margin, widely spreading, slightly falcate, ovate, maximum size about 1.0 × 0.7 mm. but often considerably smaller, especially on the branches, antical margin scarcely arching across axis, strongly curved from base to apex, postical margin straight or slightly curved, apex broad and rounded, margin sparingly but sharply dentate or spinose except near the base, the teeth irregular, varying from projecting cells to structures five cells long and three cells wide at base, the large teeth more usual on branch-leaves, teeth along postical margin no larger than the others and sometimes obsolete; lobule subtriangular in outline, about 0.2 mm. long, inflated at base, more or less plane and appressed to lobe in outer part, free margin straight or nearly so (forming one side of the triangle), entire except for the apical tooth, the latter mostly consisting of two superimposed cells arising from a base two or three cells wide, hyaline papilla usually arising from the inner surface of one of these basal cells, sinus short and straight; lobule often poorly developed; cells of lobe plane or nearly so, averaging 17 μ at the margin, 32 × 25 μ in the middle and 32 μ at the base, trigones minute, triangular, intermediate thickenings frequent, narrowly elliptical, apparently never confluent: underleaves distant, orbicular, 0.2 mm. long, plane, entire or subcrenulate from projecting cells, attached by a strongly arched line and often narrowly decurrent at base: inflorescence dioicous: ♀ inflorescence usually borne on a more or less elongated branch, more rarely on a short branch, innovating on one side, the innovation short and sterile or soon again floriferous; bracts obliquely spreading, the lobules represented by minute basal folds, lobe ovate, 0.7–1.0 mm. long, 0.4–0.7 mm. wide, spinose-dentate; bract subtending innovation narrowly winged along keel; bracte-

ole free, narrowly oblong or obovate, 0.4–0.7 mm. long, 0.2–0.35 mm. wide, entire or vaguely crenulate; perianth about half exserted, obovate in outline, 1.2 mm. long, 0.8 mm. wide, cuneate toward base, broad and truncate or slightly retuse at the apex with a short beak, postical surface with a broad and low keel, smooth or with an occasional tooth near the apex, lateral wings extending to below the middle, two or three cells broad, usually bearing from four to nine teeth, those in the apical region spine-like, sometimes three or four cells long and two or three cells wide at the base, those along sides smaller and sometimes reduced to single projecting cells: ♂ inflorescence occupying a more or less elongated branch, simple or sparingly subdivided, apparently never proliferating; bracts distant to contiguous, usually in from four to twelve pairs, the lobe widely spreading, ovate, 0.5 mm. long, 0.3 mm. wide, plane or nearly so, spinose-dentate, teeth usually four or five, the apical sometimes a little larger than the others, lobule strongly inflated, ovate in outline, 0.25 mm. long, 0.17 mm. wide, free margin revolute and appressed to lobe except in apical region, the apical tooth sometimes as in the leaves but more frequently poorly developed or obsolete, sinus straight or nearly so; antheridia borne singly or in pairs; bracteoles distant, orbicular, 0.15 mm. long, entire: mature sporophyte not seen. (PLATE 27, FIGURES 11–19.)

On leaves in damp woods. Jamaica: Lapland near Catadupa, 600 m. altitude, *Harris* (*11119 p. p.*).

If the genus *Odontolejeunea* is accepted in the restricted sense recently recommended by the writer,* *O. longispica* is the third species to be definitely recorded from the West Indies, the two others being *O. lunulata* (Web. f.) Schiffn., the type of the genus, and *O. Sieberiana* (Gottsche) Schiffn. Both of these species are widely distributed in tropical America. The lobule in *O. longispica* is a little aberrant because it bears but a single tooth and because the hyaline papilla, although displaced from the margin, is often borne on a marginal cell. In all other respects the species is a typical member of the genus.

When compared with *O. lunulata*, in which the inflorescence is also dioicous, *O. longispica* is found to be much less robust. The leaves are smaller, the local thickenings of the cell-walls are less pronounced and sometimes scarcely apparent, the underleaves are more distant, much smaller, and entire. In the perichaetial

* Bull. Torrey Club 31: 183. 1904. *O. lunulata* and *O. Sieberiana* are also described and figured in this paper.

bracts the lobes are usually spinose-dentate, the teeth being larger, fewer, and more irregular than in *O. lunulata*, and the same difference is shown by the lateral wings of the perianth. The antheridial spikes yield differential characters which are even more important. Although the number of bracts which they bear is no larger than in *O. lunulata*, the spikes appear longer because the bracts are further apart and sometimes do not overlap at all. The lobes of the bracts show but few modifications when compared with ordinary branch-leaves, and the bracteoles are distant instead of being imbricated. The sexual branches in *O. longispica* scarcely adhere to the substratum because the radicelliferous discs on the underleaves are poorly developed and rarely give rise to rhizoids. Most of the peculiarities which separate the new species from *O. lunulata* will also separate it from the paroicous *O. Sieberiana*. In exceptional cases the underleaves and bracts in this species are entire and the postical surface of the perianth shows a few scattered teeth in the upper part, but the resemblance to *O. longispica* stops here. The plants are fully as robust as in *O. lunulata*, the lobules bear several teeth along the free margin, and the short male spikes have imbricated bracteoles.

Another species which bears a strong resemblance to *O. longispica* is *Plagiomnicoma affixa* Tayl.,* which also seems to be confined to the island of Jamaica. Through the kindness of Professor Farlow the writer has been able to examine the type material of this species from the Taylor herbarium. It grew mixed with *Radula Grevilleana* Tayl. on leaves of *Danaea alata* and consists of a few fragmentary female plants with perianths. The species should apparently be referred to *Odontolejeunea*, in spite of the fact that the leaves are much less toothed than is usual, while the wings of the perianth are either entire or subdenticulate. The double innovations which subtend the female flowers would also be somewhat aberrant in this genus. All of these peculiarities will help to separate *P. affixa* from *O. longispica*. The lobules in the two species are very similar, but in *P. affixa* there are sometimes indications of a second tooth between the apical tooth and the base; the apical tooth itself consists of only one or two cells and bears the hyaline papilla on its inner surface. The leaf-

* Ann. & Mag. Nat. Hist. 20: 380. 1847.

cells in *P. affixa* are exceedingly delicate, and the trigones are difficult to demonstrate.

Vegetative reproduction in *O. longispica* is carried on by means of leafy propagula, which are very similar to those already noted in *O. lunulata* and *O. Sieberiana*.* All that were seen still attached were situated behind perigonial bracts, but it is hardly to be supposed that they are restricted to this position. The underleaves of the propagula are almost exactly the same as in *O. lunulata*, the second one showing a large radicelliferous disc with two layers of coalesced rhizoids, precisely as in that species. The leaves, however, exhibit a number of differences and are modified to an even greater degree. The first leaf is more or less reflexed and is abruptly contracted at the apex into a long point. The other marginal teeth are numerous but very minute, each one usually consisting of a single projecting cell. The second, third, and fourth leaves are also sharp-pointed at the apex, but the other teeth tend to become more scattered and larger, so that by the time the fifth leaf is reached, the distinction in size between the apical and marginal teeth is scarcely apparent. The lobules of the first four or five leaves are represented by minute basal folds, and the apex consists of a single projecting cell, which bears the hyaline papilla on its inner surface. Occasionally one of these rudimentary lobules will show vague indications of a second tooth between the apex and base, thus indicating perhaps an approach to other members of the genus. A tendency to branch is sometimes shown very soon by the propagula, and in one observed instance a male spike arose directly behind the second leaf.

Brachiolejeunea bahamensis sp. nov.

Dull green, varying to brown or almost black, scattered or growing in depressed mats: stems 0.14 mm. in diameter, sparingly and irregularly pinnate, the branches all conforming to the *Lejeunea* type, obliquely to widely spreading, similar to the stem or with somewhat smaller leaves, never microphyllous: leaves imbricated, the lobe suberect and convolute about the stem when dry, widely spreading and more or less squarrose when moist, slightly falcate, convex, oblong-ovate, 0.9 mm. long, 0.5 mm. wide, rounded to subcordate at base, antical margin strongly out-

* Bull. Torrey Club 31: 191. 1904.

wardly curved to the rounded or obtuse apex, postical margin slightly curved, margin everywhere entire; lobule ovate-triangular in outline, 0.5 mm. long, 0.25 mm. wide, the inflated portion forming a conical water-sac extending along the keel and about half as long as the lobe, keel straight or slightly arched, distinctly indented in outer part and usually forming a continuous line with postical margin of lobe, free margin rounded or subcordate at base, appressed to lobe for about two thirds its length and then passing by a straight or very shallow sinus into the postical margin of lobe, appressed portion usually with five or six teeth, the innermost rounded, the others (including the outermost or apical) mostly three or four cells long and one or two cells wide at base, often curved toward the surface of lobe, hyaline papilla at proximal base of outermost tooth, slightly displaced from the margin but sometimes borne on the antical surface of a marginal cell; cells of lobe plane or a little convex, averaging 13 μ at the margin, 25 × 18 μ in the middle and 30 × 23 μ at the base, trigones distinct, triangular but usually with one concave and two convex sides, intermediate thickenings infrequent, oval: underleaves loosely imbricated, plane, broadly orbicular, 0.35 mm. long, 0.4 mm. wide, rounded to minutely auriculate at the base, rounded to truncate at the apex, margin entire: inflorescence autoicous: ♀ inflorescence usually borne on a more or less elongated branch, more rarely on a very short branch, innovating on both sides, rarely on but one, the innovations widely spreading, sterile or soon again floriferous; bracts obliquely spreading, sharply complicate with a narrow and entire wing along keel, lobe broadly ovate, 0.8 mm. long, 0.5 mm. wide, obtusely pointed, irregularly sinuate, lobule oblong, 0.4 mm. long, 0.12 mm. wide, adnate for most of its length, apex obtuse, acute, or apiculate; bracteole free or nearly so, oval or oblong, 0.7 mm. long, 0.4 mm. wide, rounded to truncate at the apex; perianth about half exserted, ovoid, 0.9 mm. long, 0.5 mm. wide, cuneate toward base, rounded to truncate at apex with a short beak, scarcely compressed, ten-keeled (four antical, four postical, and two lateral), the keels rounded, extending to the middle or below: ♂ inflorescence usually on a leading branch, terminal or becoming intercalary by proliferation; bracts imbricated, mostly in from three to ten pairs, diandrous, similar to the leaves but with more obliquely spreading, shorter lobes and relatively broader and more inflated lobules, the free margins of the latter being more irregularly toothed, keel strongly arched; bracteoles imbricated, similar to the underleaves: capsule 0.4 mm. in diameter; spores minutely verruculose, about 40 μ in diameter. (PLATE 28, FIGURES 1–14.)

On bark of trees. Abaco: Old Kerr's Point, *Brace* (*2027 p. p.*). New Providence: junction of Southeast and Soldiers' roads, *Coker* (*1 p. p.*); ten miles west of Nassau, *Coker* (*2*); Grant's Town, *E. G. Britton* (*562*); north slope of Blue Hills, *E. G. Britton* (*584*); Fox Hills path, *Britton & Millspaugh* (*2090*); near Tea House, *E. G. Britton* (*3191*). Watling's Island: Cockburn Town and vicinity, *Britton & Millspaugh* (*6120*). Crooked Island: road to Vauxhall, *Brace* (*4746*); Stopper Hill, *Brace* (*4816*). Cuba: Matanzas, *Britton & Wilson* (*81*). All of these localities except the last are in the Bahamian archipelago. No. 4816, from Crooked Island, may be designated the type.

When this species was first studied by the writer it was referred to *B. corticalis* (Lehm. & Lindenb.) Schiffn., and it is cited under this name by Coker in the only list of Bahamian Hepaticae which has yet been published.* The two plants resemble each other very closely in general appearance, in size, in color, in the form of the leaves and underleaves, and in the structure of the leaf-cells. They differ in inflorescence, *B. corticalis* being dioicous, and in certain characters derived from the lobules, the underleaves, and the floral organs. In *B. bahamensis* the free margin of the lobule usually bears five teeth, each three or four cells long, and the underleaves are rounded or minutely auriculate at the base; in *B. corticalis* the free margin of the lobule usually bears only four teeth, each one or two cells long, and the underleaves either have subparallel sides or are cuneate at the base. In *B. bahamensis* the divisions of the perichaetial bracts are narrowed toward the apex and more or less acute, while the lobule, which is much shorter than the lobe, is adnate for the greater part of its length; in *B. corticalis* the divisions of the bracts are rounded at the apex, and the lobule, which is nearly as long as the lobe, projects considerably beyond the keel. In *B. bahamensis* the perianth seems to be constantly ten-keeled, while in *B. corticalis* the number of keels varies from five to eight. The new species is also remarkable because all of its branches, so far as observed, conform to the *Lejeunea* type, while in *B. corticalis* branches of the *Frullania* type are not infrequent.

* In Shattuck: The Bahaman Islands 248. 1905. The true *B. corticalis* has since been collected on the island of Great Bahama and on Cat Island by Britton and Millspaugh (*2533, 2646, 2719, 2723, 5899*).

On account of its ten-keeled perianth *B. bahamensis* belongs to a group of four closely related American species, all characterized by this peculiarity. The other species belonging to this group are *B. densifolia* (Raddi) Evans, *B. chinantlana* (Gottsche) Schiffn., and the recently described *B. insularis* Evans.* *B. densifolia* is widely distributed in South America and has also been reported from the West Indies; *B. chinantlana* was originally described from Mexican specimens but has recently been found in the mountains of Jamaica; *B. insularis* is known from Cuba, Jamaica, and Puerto Rico. Of these four species *B. densifolia* and *B. chinantlana* are at once distinguished from *B. bahamensis* by their larger size and more or less pointed leaves; *B. densifolia* is further characterized by being dioicous, and *B. chinantlana* by being paroicous. In *B. insularis* the inflorescence is also paroicous, but this species comes much closer to *B. bahamensis* than the others on account of the rounded lobes of its leaves. It is, however, more robust, many of the vegetative branches conform to the *Frullania* type, the basal auricles of the underleaves are much better developed, and the margins of the lobules have more numerous and often more irregular teeth.

Symbiezidium laceratum sp. nov.

Brownish green, growing in depressed mats, similar in general appearance to *S. transversale*: stems 0.15 mm. in diameter: leaves imbricated, the lobe obliquely spreading, sometimes plane, sometimes slightly convex along antical border and concave along postical, rarely revolute at the apex, scarcely falcate, ovate-oblong, 1.2–1.3 mm. long, 0.7–0.75 mm. wide, antical margin rounded at base and arching partially across axis, then slightly outwardly curved to the broad and rounded apex, postical margin straight or nearly so, margin entire or irregularly sinuous in apical region; lobule when well developed ovate-lanceolate in general outline, 0.3 mm. long, 0.15 mm. wide, strongly inflated in basal half; cells of lobe averaging 23 μ at the margin, 30 μ in the middle, and 35 × 30 μ at the base, trigones and intermediate thickenings conspicuous: underleaves imbricated, plane or nearly so, broadly orbicular, 0.7 mm. long, 0.95 mm. wide, sometimes abruptly cuneate and short-decurrent at base but usually with the margin in this region straight and meeting the axis at approximately a right angle, apex broad, rounded or truncate, often slightly sinuous, margin otherwise

* For notes on these species, see Evans, Bull. Torrey Club 35: 158–161. 1908.

entire: inflorescence autoicous: ♀ inflorescence arising from the stem or from a leading branch; bracts obliquely to widely spreading, complicate, sometimes with a narrow and entire wing along keel, lobe oblong to obovate, 0.75 mm. long, 0.4 mm. wide, rounded at apex, lobule similar to lobe and of about the same size, rounded to obtuse at the apex; bracteole obovate, 0.7 mm. long, 0.4 mm. wide, rounded to truncate at apex; perianth about half exserted beyond the bracts, obovate, 1.2 mm. long, 0.85 mm. wide, rounded to truncate at apex with a short beak, lateral keels winged to about the middle, the wings coarsely and irregularly laciniate or lacerate to within from one to three cells of the keels, the laciniae straight or variously curved and contorted, rarely branched, usually from five to ten cells long and two cells wide at base or to beyond the middle, antical surface of perianth smooth, postical surface bearing an indefinite number of scattered laciniae, some of them often arranged in two interrupted longitudinal lines, apparently representing the two angles of an obsolete postical keel: ♂ inflorescence occupying a short lateral branch or terminal on a longer branch, occasionally borne on a subfloral innovation, apparently never proliferating; bracts in from two to six pairs, imbricated, subequally bifid, both lobe and lobule somewhat narrowed toward the rounded apex, keel not winged but slightly crenulate from projecting cells; bracteoles restricted to base of spike, similar to the underleaves but smaller: mature sporophyte not seen. (PLATE 28, FIGURES 15–20.)

On bark of trees. Hayti: Plaisance to Marmelade, 800 m. *Nash* (654).

In its autoicous inflorescence *S. laceratum* agrees with *S. barbiflorum* (Lindenb. & Gottsche) Evans, *S. vincentinum* (Gottsche) Trevis.,* and *Platylejeunea Kroneana* Steph.,† the four together constituting a group of closely related species. *S. barbiflorum* and *S. vincentinum* are rather widely distributed in tropical America and both occur in the West Indies. *P. Kroneana* is known only from the original material, collected by Krone at Santa Caterina, Brazil. This last species is erroneously described as dioicous, but a portion of the type specimen kindly communicated by its author is clearly autoicous and is so labeled on the packet. In distinguishing these four species from one another the most important characters are drawn from the bracteoles and perianths, but the leaves and underleaves sometimes yield a few supplementary differences.

* See Evans, Bull Torrey Club **34**: 540–543. *pl. 31. f. 11–14.* 1908.

† Hedwigia **35**: 117. 1896.

In *S. barbiflorum*, which is especially close to the Haytian species, the underleaves are constantly long-decurrent, and the bracteole is distinctly bifid. The two species agree in developing many laciniae on the postical surface of the perianth, but these laciniae are even more numerous in *S. barbiflorum* than in *S. laceratum* and are also characterized by being shorter and more delicate. In *S. vincentinum* the underleaves are usually broader than long, agreeing in this respect with *S. laceratum*, but they differ in being constantly decurrent. Occasionally the leaves in this species are apiculate as earlier authors have emphasized, but this condition is far from constant and many plants bear rounded leaves only. The bracteole is retuse, irregularly sinuous-crenate, or emarginate at the apex, and the perianth is either smooth on the postical surface or bears only a few scattered laciniae. The laciniae along the lateral keels tend to be shorter and less numerous than in *S. laceratum*. In *Platylejeunea Kroncana* the underleaves are also decurrent as in *S. vincentinum*, but the bracteole is undivided as in *S. laceratum*. The lateral laciniae of the perianth, however, are reduced to spine-like teeth and the postical surface is smooth or nearly so. In this species the lobules of the perigonial bracts tend to be acute or apiculate instead of rounded, but this is a difference which may well be inconstant. In the remaining species of *Symbiezidium* known from the West Indies the inflorescence is dioicous.

YALE UNIVERSITY.

Explanation of plates 26–28

The figures were all drawn by the writer and prepared for publication by Miss Hyatt.

PLATE 26.

Trachylejeunea dilatata Evans. 1. Part of plant with perianth, postical view, ×35. 2. Part of stem with branch, postical view, ×35. 3. Leaf, antical view, ×35. 4. Part of plant with two male inflorescences, postical view, ×35. 5. Cells from middle of lobe, ×265. 6. Cells from antical margin of lobe seen from postical surface, ×200. 7. Cells from margin of lobe in cross section, ×200. 8. Apex of lobule, ×200. 9. Underleaf, ×200. 10–12. Bracts and bracteole from a single involucre, ×35. 13. Transverse section of perianth in upper third, ×45. The figures were all drawn from the type specimen (*311*).

Harpalejeunea reflexula Evans. 14. Part of plant with perianth, postical view, ×45. 15. Part of stem, postical view, ×45. 16. Cells from middle of lobe, ×265. 17. Cells from antical margin of lobe, ×200. 18. Apex of lobe, ×200. 19. Apex of lobule, ×200. 20. Underleaf, ×200. 21–23. Bracts and bracteole from a single involucre, ×45. 24. Transverse section of perianth, 45. 25. Lateral keel of perianth in section, ×200. The figures were all drawn from the type specimen (*88*).

PLATE 27.

Leiolejeunea grandiflora Evans. 1. Part of plant with perianth and the bases of two branches, postical view, ×35. 2. Part of plant with male inflorescence, postical view, ×35. 3. Cells from middle of lobe, ×265. 4. Cells from antical margin of lobe, ×200. 5. Apex of lobule, ×200. 6. Half of underleaf, ×200. 7, 8. Bract and bracteole from the same involucre, ×35. 9. Bract from an unfertilized inflorescence, ×35. 10. Transverse section of perianth, ×35. The figures were all drawn from the type specimen (*6*).

Odontolejeunea longispica Evans. 11. Part of stem with the bases of three branches, postical view, ×25. 12. Female branch with perianth and innovation, postical view, ×25. 13. Short antheridial spike, postical view, ×25. 14. Cells from middle of lobe, ×200. 15. Apex of lobule, ×200. 16–18. Bracts and bracteole from the same involucre, ×25. 19. Propagulum, postical view, ×25. The figures were all drawn from the type specimen (*11119 p. p.*).

PLATE 28.

Brachiolejeunea bahamensis Evans. 1. Part of plant with perianth and proliferating antheridial spike, postical view, ×25. 2. Branch with perianth, postical view, ×25. 3. Leaf, antical view, ×25. 4. Cells from middle of lobe, ×265. 5, 6. Free margins of lobules, 45. 7. Apical tooth of lobule, ×200. 8. Basal auricle of underleaf, ×200. 9. Unfertilized female flower, the innovations dissected away, postical view, ×25. 10–12. Bracts and bracteole from the same involucre, ×25. 13. Transverse section of perianth, ×25. 14. Perigonial bracts with antheridia, postical view, ×45. Figs. 2 and 14 were drawn from specimens collected by E. G. Britton (*584*), the remaining figures from the type specimen (*4618*).

Symbiezidium laceratum Evans. 15. Part of plant with perianth, postical view, ×25. 16. Female branch, postical view, ×25. 17. Involucre and perianth, postical view, ×25. 18–20. Bracts and bracteole from the same involucre, ×45. The figures were all drawn from the type specimen (*654*).

Additional Philippine Polyporaceae

William Alphonso Murrill

A list of Philippine polypores recently added to the herbarium of the New York Botanical Garden was published in this journal about a year ago (Bull. Torrey Club **34**: 465–481. 1907). In April, 1908, a large and valuable shipment of Philippine fungi, 637 packets in all, was received for determination from the Bureau of Science, Manila, through Mr. Elmer D. Merrill, botanist. Most of these are duplicates and will become permanent additions to the Garden herbarium, but a few, not in duplicate, will be returned to Manila. The following list includes the pileate polypores of this collection, arranged in alphabetical order under their tribes.

The localities here included are very varied, representing a large number of the islands and many different altitudes and latitudes. The principal collectors are as follows: Messrs. Elmer D. Merrill, A. D. E. Elmer, E. B. Copeland, H. M. Curran, M. L. Merritt, H. N. Whitford, Eugenio Fénix, Maximo Ramos, L. Mangubat, and Mrs. Mary S. Clemens. Private numbers or letters follow the name of the collector, those given in parenthesis being assigned by the Bureau of Science or the Bureau of Forestry. Synonyms listed in my former paper are not repeated here except in connection with discussions relative to additional knowledge or notes of interest.

Tribe POLYPOREAE

Bjerkandera adusta (Willd.) Karst. Medd. Soc. Faun. Fl. Fenn 5: 38. 1879.

Mindanao: Mt. Apo, 2000 m., Davao, *Copeland 1075*; Camp Keithley, Lake Lanao, *Clemens bj.*

Coltricia benguetensis Murrill, sp. nov.

Sporophore consisting of several pilei arising on short stipes from a thickened base attached to the host at two points, the pilei being in all stages of development; pileus flabelliform to reniform, usually umbonate behind at the point of attachment, slightly con-

vex above and below, corky, rigid, 3–4 × 4–5 × 0.5–0.8 cm.; surface anoderm, subglabrous, uneven, neither sulcate nor zonate, fulvous behind, ferruginous in front; margin broadly sterile, rather thick, rounded, ferruginous, context ferruginous, corky, zonate, homogeneous, 5 mm. thick; tubes 1–2 mm. long, pallid within, mouths cinereous-fuscous, glistening, regular, angular, 5 to a mm., edges thin, subentire: hyphae ferruginous, 2–3 μ; cystidia scanty, pointed, straight, curved or sinuous, bulbous at the base, dark fulvous, 25–40 μ long, 7–10 μ thick at the thickest part.

Type collected about prostrate logs of *Pinus insularis* at Baguio, Benguet Province, Luzon, October–November, 1905, by E. D. Merrill, (*5003*). Also collected on the same host in Benguet Province, March, 1904, by A. D. E. Elmer, *6047*.

CORIOLOPSIS BADIA (Berk.) Murrill, Bull. Torrey Club **34**: 466. 1907. *P. asper* Jungh., *P. strigatus* Berk., and *P. squamaeformis* Berk. hardly differ specifically from this species. Specimens have also been called *P. brunneopictus* Berk., described from Brazil. In the two collections made by Mrs. Clemens in Mindanao, the pores are much larger than usual, being at least twice their normal size.

Luzon: Montalban, Rizal Province, *Merrill*, (*5085*); Mt. Mariveles, Bataan Province, *Copeland 158*; Bauang, Union Province, *Elmer 5710*; Mt. Arayat, Pampanga Province, *Merrill*, (*5031*); Santa Maria Mavitac, Laguna Province, *Curran*, (*8930*). Mindanao: Camp Keithley, Lake Lanao, *Clemens av, ay*.

CORIOLOPSIS CAPERATA (Berk.) Murrill, N. Am. Flora **9**: 77. 1908. *Polyporus caperatus* Berk. Ann. & Mag. Nat. Hist. **3**: 391. 1839. (Type from the Philippines.)
Mindanao: Mt. Apo, 1300 m., Davao, *Copeland 1178*.

Coriolopsis Copelandi Murrill, sp. nov.

Pileus subimbricate, dimidiate, sessile, laterally confluent, broadly attached, very slightly flexible, conchate, 3–4 × 5–6 × 0.3–0.5 cm.; surface glabrous,. thinly encrusted, very shallowly sulcate, slightly radiate-rugose when dry, opaque, very dark brown or black; margin rather thick, sterile, entire: context punky, dark fulvous, 1–2 mm. thick; tubes 3–4 mm. long, dark brown within, hymenium sordid brown, almost blackish in some specimens, cracking when dry, mouths minute, thin-walled, angular, 7–9 to a mm., edges entire to slightly fimbriate.

Type collected on dead wood in Davao, Mindanao, March 28, 1904, by E. B. Copeland *714*. Also collected at Todaya, Davao, Mindanao, April 25, 1904, by E. B. Copeland, (*1214*), and on a dicotyledonous log on the Lamao River, Luzon, February 2, 1904, by E. B. Copeland, *147*.

Coriolopsis bataanensis Murrill, sp. nov.

Pileus thin, soft, slightly flexible, rather fragile, dimidiate to flabelliform, often laterally extended by confluence, narrowly attached, conchate, 3–4 × 3–10 × 0.3–0.5 cm.; surface spongy-tomentose, anoderm, very uneven, sulcate, subzonate, fulvous, varying to isabelline or fuliginous in places; margin rather thin, undulate, isabelline: context 2–4 mm. thick, two-layered, soft and dull fulvous above, considerably harder and ochraceous next to the tubes, which are 1–2 mm. long, bay within, mouths glistening, isabelline to bay, distinctly angular, 3–4 to a mm., quite variable in size, edges thin, entire: spores smooth, ovoid, hyaline, rather abundant, 5 × 4 μ; hyphae subhyaline, extremely fragile; cystidia none.

Type collected on dead wood on Mt. Mariveles, 230 m., Bataan Province, Luzon, January 29, 1904, by E. B. Copeland, *143*.

CORIOLOPSIS DERMATODES (Lév.) Murrill, Bull. Torrey Club **34**: 466. 1907. *Polyporus xeranticus* Berk., described from India, is hardly different from this species.

Mindanao: Camp Keithley, Lake Lanao, *Clemens*, two collections. Luzon: Sablan, Benguet Province, *Elmer 6183*; Bauang, Union Province, *Elmer 5747*; Bosoboso, Rizal Province, *Ramos*, (*2158*).

Coriolopsis melleoflava Murrill, sp. nov.

Pileus thin, coriaceous, very flexible, broadly effused, narrowly attached, dimidiate to subcircular, 2–3 cm. long, 1 mm. thick, extending several centimeters laterally by confluence; surface clothed with dense short tomentum, many times narrowly concentrically sulcate, melleoflavous, slightly brownish behind; margin undulate or irregularly notched or lobed, thin, sterile, pallid: context melleoflavous, membranous; tubes less than a mm. long, nearly white within, mouths pale melleous, irregular, averaging 2 to a mm., edges notched and more or less elongated, somewhat irpiciform.

Type collected on dead wood at Zamboanga, Mindanao, January, 1908, by H. N. Whitford and W. I. Hutchinson, (*9238*).

CORIOLOPSIS OCCIDENTALIS (Kl.) Murrill, Bull. Torrey Club 32: 358. 1905.

Mindanao: Camp Keithley, Lake Lanao, *Clemens ap, m*; Pollok Harbor, *Copeland 331*. Negros: Gimagaan River, *Copeland 4*. Mindoro: Bongabong River, *Whitford 1440, 1441*. Batanes: *Fénix, (3868), (3871), (3885), (3888)*. Luzon: Twin Peaks, Benguet Province, *Elmer 6356*; Lamao Forest Reserve, *Curran (7397)*.

CORIOLOPSIS SEMILACCATA (Berk.) Murrill, Bull. Torrey Club 34: 466. 1907.

Luzon: Lamao, Bataan Province, *Copeland 172, Curran, (7521)*; Bosoboso, Rizal Province, *Ramos, (1217)*; Mauban, Tayabas Province, *Curran, (9590)*. Mindoro: Mt. Halcon, *Merrill, (6119)*. Mindanao: Camp Keithley, Lake Lanao, *Clemens ac* and one other collection; Davao, *Copeland 552*. Negros: Gimagaan River, *Copeland 14*.

Coriolopsis subcrocata Murrill, sp. nov.

Pileus coriaceous, membranous, flaccid, elastic, effused-reflexed: the reflexed portion dimidiate, applanate, 1–2 cm. long and 1 mm. thick, extending laterally several centimeters; surface pale isabelline, nearly glabrous, very slightly zonate; margin thin, concolorous, entire, sterile: context pale isabelline, soft, very thin; tubes less than 1 mm. long, paler than the context, mouths regular, subcircular, glistening, 3 to a mm., edges firm, corky, entire.

Type collected on a dead trunk and branches on Mt. Mariveles, Bataan Province, Luzon, January 1, 1904, by E. D. Merrill, *(3694)*.

CORIOLUS ATYPUS (Lév.) Pat. Tax. Hymén. 94. 1900.

Palawan: Victoria Peak, *Curran, (7484)*. Mindoro: Mt. Halcon, *Merrill, (6121), (6122)*. Luzon: Rizal Province, *Ramos, (1859), (1864)*; Lamao River, Bataan Province, *Copeland 171, 179*; Mt. Mariveles, Bataan Province, *Copeland 169*; Zambales Province, *Curran, (7020)*; Mauban, Tayabas Province, *Curran, (9587)*. Mindanao: Zamboanga, *Whitford & Hutchinson, (9302)*; Malita, Davao; *Copeland 683*.

Coriolus Clemensiae Murrill, sp. nov.

Pileus rather thin, rigid, reniform, conchate, attached by a compressed projecting base resembling a stipe, 6 × 8 × 0.3 cm., base 2 × 2 × 0.3 cm.; surface glabrous, zonate, radiately furrowed

white with a slightly grayish tinge, the narrow zones shining; margin rather thick, fertile, reddish brown in dried specimens, subentire: context milk-white, fibrous, 1–2 mm. thick; tubes pale ochraceous when dry, 2 mm. long, mouths concolorous, 4–5 to a mm., circular to angular, edges firm, rather thick, entire: spores subglobose, smooth, hyaline, 3–4 μ; hyphae hyaline, 3–4 μ; cystidia none.

Type collected on dead wood at Camp Keithley, Lake Lanao, Mindanao, September–October, 1907, by Mary S. Clemens, *v.*

Coriolus Currani Murrill, sp. nov.

Pileus flabelliform, thin, somewhat flexible, almost plane above, slightly concave below, affixed by a short tubercle resembling the pileus in surface and substance, 3–5 × 4–6 × 0.1–0.3 cm.; surface isabelline to wood-brown, glabrous, shining, multizonate, smooth between the shallow concentric furrows; margin acute, entire or undulate, pallid, sterile in a narrow distinct band: context white to pallid, homogeneous, punky, 1–1.5 mm. thick; tubes white to pale yellowish throughout, 1–2 mm. long, mouths glistening, circular, very regular, 5–6 to a mm., edges firm, entire, obtuse.

Type collected on dead wood on Mt. Maquiling, Laguna Province, Luzon, October 23, 1907, by H. M. Curran and M. L. Merritt, (*8965*). Also collected as follows: Mt. Maquiling, Laguna Province, Luzon, October 23, 1907, by H. M. Curran and M. L. Merritt, (*8964*); Rizal Province, Luzon, January, 1907, by Maximo Ramos, (*1866*); Batangas Province, Luzon, November, 1907, by H. M. Curran and M. L. Merritt.

CORIOLUS ELONGATUS (Berk.) Pat. Tax. Hymén. 94. 1900.

Luzon: Santa Maria Mavitac, Laguna Province, *Curran*, (*8909*).

CORIOLUS MAXIMUS (Mont.) Murrill, Bull. Torrey Club 34: 467. 1907.

Mindanao: Mungalaron, Davao, *Copeland 712;* Camp Keithley, Lake Lanao, *Clemens a, k, s, aq;* Port Banga, Zamboanga District, *Whitford & Hutchinson*, (*9411*). Luzon: Lamao River, Bataan Province, *Copeland 174;* Mt. Malaraya, Tayabas Province, *Curran & Merritt*, (*8958*); Zambales Province, *Curran* (*7025*). Balabac: *Mangubat*, (*534*). Mindoro: Bongabong River, *Whitford 1438.*

CORIOLUS MURINUS (Lév.) Pat. Tax. Hymén. 94. 1900.

Luzon: Lamao River, Bataan Province, *Copeland 170, 185,*

247; Mauban, Tayabas Province, *Curran*, (*9591*), (*9592*); Paete-Piapi, Laguna and Tayabas Provinces, *Curran*, (*9640*), (*9644*); Caraga, Surigao Province, *Merrill*, (*5460*). Mindanao: Camp Keithley, Lake Lanao, *Clemens c*; Davao, *Copeland 458*, *925*. Negros: Gimagaan River, *Copeland 5*. Lumbacan: *Merrill* (*5281*).

CORIOLUS NIGROMARGINATUS (Schw.) Murrill, Bull. Torrey Club 32: 649. 1906.

Mindoro: Mt. Halcon, *Merrill*, (*6116*). Negros: Gimagaan River, *Copeland 9*. Luzon: Santa Maria Mavitac, Laguna Province, *Curran*, (*8927*); Antipolo, Rizal Province, *Curran*, (*7042*); Montalban, Rizal Province, *Merrill*, (*5081*). Mindanao: Malita, Davao, *Copeland 668*; Davao, *Copeland 876*; Camp Keithley, Lake Lanao, *Clemens N, af, cg, r.*

CORIOLUS PROLIFICANS (Fr.) Murrill, N. Am. Flora 9: 27. 1907.

Luzon: Lamao Forest Reserve, Bataan Province, *Curran*, (*7396*).

Coriolus perpusillus Murrill, sp. nov.

Pileus very small, irregular, laterally confluent, dimidiate, broadly attached, 0.5–1 × 1.5 × 0. 2–0.3 cm., surface milk-white, azonate, glabrous, not polished; margin concolorous, entire, sterile, rather thick: context milk-white, punky, fibrous, 1 mm. thick; tubes white to slightly yellowish, very thin-walled, 1 mm. or less long, mouths glistening, nearly white, regular, angular, 6 to a mm., edges thin, toothed or fimbriate.

Type collected on dead wood at Camp Keithley, Lake Lanao, Mindanao, July, 1907, by Mary S. Clemens, *bf*.

Coriolus rubritinctus Murrill, sp. nov.

Pileus small, slightly flexible, obovate to flabelliform, more or less cuneate behind, plane above and below, laterally confluent at times, 1.5–2 × 1.5–2.5 × 0.1–0.3 cm.; surface faintly zonate, smooth, glabrous, opaque, ochraceous-fulvous with reddish brown blotches; margin abruptly acute, fertile, concolorous, entire, slightly inflexed on drying: context pallid, punky-fibrous, 1 mm. or less thick; tubes pallid, 2 mm. long, mouths glistening, ochraceous to discolored, regular, angular, 4–5 to a mm., edges corky, thin, entire: spores globose, smooth, hyaline, 2.5–3 μ; hyphae hyaline, 3 μ; cystidia none.

Type collected on dead wood on Mt. Halcon, Mindoro, November, 1906, by E. D. Merrill (*6117*).

Coriolus subvernicipes Murrill, sp. nov.

Pileus flabelliform or reniform, subimbricate, thickest behind, becoming very thin and flexible at the margin, narrowly attached, somewhat irregular and plicate, 2–4 × 4–7 × 0.1–0.6 cm.; surface lustrous, glabrous, multizonate, reddish brown, isabelline in a few zones, finely radiate-striate; margin very thin, slightly paler, broadly sterile, notched or irregular: context milk-white, tough, 1–5 mm. thick; tubes short, white to pale yellowish, firm, 1 mm. or less long, mouths glistening, nearly circular, regular, 4–5 to a mm., edges rather thin, entire.

Type collected on dead *Cassia* at Bosoboso, Rizal Province, Luzon, February, 1907, by Maximo Ramos, (*2144*). No. (*2145*) is the same species, collected at the same time.

Cycloporellus barbatus Murrill, sp. nov.

Pileus reniform, conchate, thin, flexible, imbricated at times, attached by a short umbo, 3–4 × 5–6 × 0.05–0.1 cm.; surface multizonate, shallowly concentrically sulcate, light brown to dark reddish brown, covered with coarse, blackish brown, appressed hairs 2 mm. or more in length; margin thin, pallid, entire, narrowly sterile: context very thin, fibrous, containing blackish, horny layers; tubes less than 1 mm. long, dark fulvous within, the cavities hoary, mouths regular, angular, glistening, dark brown, 6–7 to a mm., edges entire, becoming thin: spores subglobose, smooth, hyaline, 2–3 μ; hyphae melleous to dark fulvous, 3.5–5 μ; cystidia blackish brown, opaque, slender, hyaline at the tip, regular in shape, rather abundant, 15–25 μ long, 4 μ thick at the base, tapering to a point.

Type collected on dead wood in Zambales Province, Luzon, November–December, 1907, by H. M. Curran and M. L. Merritt, (*8208*).

CYCLOPORELLUS CICHORIACEUS (Fr.) Murrill, Bull. Torrey Club 34: 468. 1907. *Favolus transiens* Cesati, described from Borneo, is not distinct from this species.

Batanes: *Fénix*, (*3874*). Mindanao: Mt. Apo, 2000 m., Davao, *Copeland 1067*.

CYCLOPORELLUS MICROCYCLUS (Lév.) Murrill, Bull. Torrey Club 34: 468. 1907. *Polystictus xerampelinus* Kalchb., described from Australia, should be added to the synonyms of this species.

Luzon: Montalban, Rizal Province, *Merrill*, (*5086*); Mt. Malaraya, Tayabas Province, *Curran & Merritt*, (*8960*); Rizal Province, *Ramos*, (*1860*), *Foxworthy*, (*84*); Mt. Mariveles, 333 m., Bataan Province, *Copeland 144*. Mindanao: Camp Keithley, Lake Lanao, *Clemens ae, ah, ca, j*.

EARLIELLA CORRUGATA (Pers.) Murrill, Bull. Torrey Club 34: 468. 1907.

Luzon: Mount Maquiling, Laguna Province, *Merrill*, (*5153*); Mount Maquiling, Batangas Province, *Curran & Merritt*, (*8940*); Lamao River, Bataan Province, *Copeland 164*. Panay: Capiz, *Copeland 19*. Balabac: *Mangubat*, (*535*). Mindanao: Davao, *Copeland 477, 518*: Catalonan, Davao, *Copeland 924*; Camp Keithley, Lake Lanao, *Clemens cd, ao*; Caraga, Surigao Province, *Merrill*, (*5459*).

Favolus resinosus Murrill, sp. nov.

Pileus sessile, dimidiate, applanate, rigid, attached by a broad base, 6× 10× 1–2 cm.; surface anoderm, glabrous, opaque, brown to black, more or less resinous, proliferous, becoming incrusted with age; margin abruptly acute, isabelline with a tinge of flesh-color, undulate or coarsely notched: context corky to indurate, brown with a reddish hue, 2–3 mm. thick; tubes 1 cm. long, large, light brown within, mouths ochraceous, subhexagonal, rigid, 1–2 mm. in diameter, radiately elongated near the margin, reaching 4 mm. at times, edges rather thick, entire: spores subglobose to ovoid, smooth, hyaline, 4–6 μ long; hyphae hyaline, 3–4 μ; cystidia none.

Type collected on dead wood at Bosoboso, Rizal Province, Luzon, July, 1906, by Maximo Ramos, (*1214*).

Favolus subrigidus Murrill, sp. nov.

Pileus sessile, dimidiate, thin, tough, slightly flexible, 2–3 × 3–4 × 0.2–0.3 cm.; surface very finely tomentose to glabrous in zones, reddish brown behind, isabelline in front, radiate-rugose; margin thin, broadly sterile, reddish brown when dry, nearly entire: context pale isabelline, punky-fibrous, 1–2 mm. thick; tubes regular, hexagonal, very shallow in front, 1 mm. deep behind, white throughout, mouths 2 to a mm., edges rigid, entire, at first thick, becoming thinner with age.

Type collected on dead wood at Mauban, Tayabas Province, Luzon, March, 1908, by H. M. Curran, (*9593*).

FAVOLUS TENUIS (Hook.) Murrill, Bull. Torrey Club 32: 100. 1905.

Luzon: Santa Maria Mavitac, Laguna Province, *Curran*, (*8908*), (*8910*), (*8911*), (*8913*); Lamao River, Bataan Province, *Copeland 248*; Sablan, Benguet Province, *Elmer 6141*, *6180*; Antipolo, Rizal Province, *Curran*, (*7043*); Mt. Mariveles, Bataan Province, *Copeland 158a*; Irisan, Benguet Province, *Elmer 5947*; Rizal Province, *Ramos*, (*1862*); Montalban, Rizal Province, *Merrill*, (*5090*). Camiguin: Babuyanes, *Fénix*, (*4153*), (*4156*), (*4157*). Babuyan: *Fénix*, (*3931*). Batanes: *Fénix*, (*3889*). Mindanao: Davao, *Copeland 494*, *832*; San Ramon, Zamboanga District, *Copeland*; Camp Keithley, Lake Lanao, *Clemens P, aw.*

FAVOLUS WIGHTII (Kl.) Ricker, Philipp. Jour. Sci. 1: Suppl. 286. 1906.

LUZON: Lamao Forest Reserve, Bataan Province, *Curran*, (*7388*); Lamao, Bataan Province, *Curran*, (*7527*); Mt. Mariveles, Bataan Province, *Merrill*, (*3692*); Mauban, Tayabas Province, *Curran*, (*9589*); Mt. Malaraya, Tayabas Province, *Curran & Merritt*, (*8956*). Mindanao: Davao, *Copeland 635*.

FUNALIA FUNALIS (Fr.) Pat. Tax. Hymén. 95. 1900. This species is not very distinct from *Funalia villosa*.

Luzon: Bulacan Province, *Curran*, (*7181*); Twin Peaks, Benguet Province, *Elmer 6355* (specimen young and doubtfully referred to this species).

FUNALIA LEONINA (Kl.) Pat. Tax. Hymén. 95. 1900. *Polyporus Dybowskii* Pat. Bull. Soc. Myc. Fr. 8: 53. *pl. 7. f. 6.* 1892.

Luzon: Montalban, Rizal Province, *Merrill*, (*5082*).

FUNALIA PHILIPPINENSIS Murrill, Bull. Torrey Club 34: 469. 1907.

Luzon: Lamao, Bataan Province, *Copeland 157*.

HAPALOPILUS GILVUS (Schw.) Murrill, Bull. Torrey Club 31: 418. 1904.

Luzon: Mt. Mariveles, Bataan Province, *Merrill*, (*3697*); Lamao River, Bataan Province, *Copeland 191*.

HAPALOPILUS LICNOIDES (Mont.) Murrill, Bull. Torrey Club 31: 417. 1904.

Luzon: Mt. Mariveles, 230 m., Bataan Province, *Copeland 192;* Lamao, Bataan Province, *Curran,* (*7543*). Mindanao: Camp Keithley, Lake Lanao, *Clemens b, l;* Todaya, Davao, 1200 m., *Copeland 1275.*

HAPALOPILUS MALAIENSIS (Cooke) Murrill. *Polystictus malaiensis* Cooke, Grevillea **14**: 13. 1885. (Type from Perak.) This is written *P. malaccensis* on the type sheet at Kew and is so printed in Saccardo. The species is easily distinguished by its large pores.

Luzon: Lamao Forest Reserve, Bataan Province, *Curran,* (*7394*); Twin Peaks, Benguet Province, *Elmer 6344.* Mindanao: Mt. Apo, 530 m., Davao, *Copeland 1155.*

Hapalopilus Ramosii Murrill, sp. nov.

Pileus distorted by change of position of host, new pilei appearing in an imbricate fashion on both surfaces of the now erect older sporophore, sessile, dimidiate, corky, thickest behind, becoming very thin at the margin, convex or applanate above, 2–3 × 4–5 × 0.5–1 cm.; surface anoderm, slightly uneven, azonate, finely hirtose-tomentose, fulvous; margin acute, subentire, concolorous or slightly paler, sterile: context fulvous, homogeneous, 2–4 mm. thick; tubes grayish umbrinous within, 2–4 mm. long, mouths minute, 7 to a mm., subangular, regular, glistening, changing color with the direction of the light from dark fulvous to bay, edges thin, firm, entire: spores subglobose, smooth, hyaline, 3–4 μ; hyphae ferruginous, 3 μ; cystidia slender, fulvous, pointed, bent at the base, scanty, 15–25 × 5–6 μ.

Type collected on dead *Calophyllum Inophyllum* near Bosoboso, Rizal Province, Luzon, July, 1906, by Maximo Ramos, (*1198*).

HAPALOPILUS SUBRUBIDUS Murrill, Bull. Torrey Club **34**: 470. 1907.

Luzon: Sablan, Benguet Province, *Elmer 6134;* Mt. Mariveles, Bataan Province, *Copeland 166.* Mindanao: Camp Keithley, Lake Lanao, *Clemens ag;* San Ramon, Zamboanga, *Copeland 739.* What appears to be a young, thin form of this species was collected by Curran and Merritt, (*8970*), on Mt. Maquiling, Laguna Province, Luzon, Oct. 23, 1907.

HEXAGONA CUCULLATA (Mont.) Murrill, Bull. Torrey Club **31**: 332. 1904.

Batanes: *Fénix,* (*3887*).

Hexagona luzonensis Murrill, sp. nov.

Pileus flabelliform, tapering behind, 3 × 4 × 0.2–0.3 cm.; surface isabelline, becoming grayish-tinted when dry, glabrous, radiate-striate, tessellate near the margin, which is rather firm, entire, opaque, strongly inflexed on drying: context soft, white to isabelline, 1 mm. thick behind, very thin near the margin, rather fragile; tubes large, decurrent, white to discolored, 1–2 mm. long, mouths 1–2 × 1 mm., edges thin, somewhat fimbriate: stipe lateral, short, thick, white, glabrous, 5 × 5 mm.

Type collected on dead wood at Lamao, Bataan Province, Luzon, September, 1907, by H. M. Curran, (*7541*).

Hexagona pertenuis Murrill, sp. nov.

Pileus flabelliform, cuneate behind, 2–3 × 1.5–2.5 × 0.05 cm.; surface white, glabrous, faintly radiate-striate, tessellate near the margin, which is very thin, translucent, undulate, rarely toothed in places, fissured in age: context very thin, white, somewhat elastic when dry, but easily broken; tubes decurrent, white, becoming ochraceous, very shallow, of the usual elongated hexagonal form, mouths 0.5 × 0.25 mm., edges thin, slightly fimbriate: stipe very short, 3 mm. long, 1–2 mm. thick, lateral, cylindrical, concolorous, hardly umbilicate above.

Type collected on dead wood on Mt. Malaraya, Tayabas Province, Luzon, November, 1907, by H. M. Curran and M. L. Merritt, (*8948*).

HEXAGONA PHILIPPINENSIS (Berk.) Ricker, Phil. Jour. Sci. **1**: Suppl. 4. 287. 1906. *Polyporus philippinensis* Berk. Lond. Jour. Bot. **1**: 148. 1842. (Type from the Philippines, collected by Cuming.) *Favolus philippinensis* Sacc. Syll. Fung. 6: 393. 1888. Very similar to *P. grammocephalus* above, but tubes very much larger and elongated-hexagonal. *Leucoporus hirto-lineatus* Pat., described from Java, can hardly be different from this species, judging from the description.

Luzon: Lamao, Bataan Province, *Copeland 1407*.

Inonotus Clemensiae Murrill, sp. nov.

Sporophore large, imbricate, uniformly dark fulvous-brown throughout; pileus sessile, dimidiate, conchate, rigid, fragile when dry, 5–7 × 10–15 × 1–1.5 cm.; surface soft, anoderm, azonate, short-tomentose, slightly radiate-rugose; margin thick, fertile, irregularly notched or undulate: context spongy-fibrous, homogeneous, averaging 1 cm. in thickness; tubes 5 mm. long, mouths

angular, 2–3 to a mm., edges thin, entire : spores ellipsoid, smooth, pale fulvous, 6–9 × 5–6 μ; hyphae thick, ferruginous; cystidia none.

Type collected on dead wood at Camp Keithley, Lake Lanao, Mindanao, September–October, 1907, by Mary S. Clemens, *as.*

INONOTUS FRUTICUM (B. &. C.) Murrill, Bull. Torrey Club 31: 601. 1904.

Balabac: *Mangubat*, (*531*).

LAETIPORUS SPECIOSUS (Batt.) Murrill, Bull. Torrey Club 31: 607. 1904.

Luzon: Mt. Isidro, Pangasinan Province, *Curran & Merritt*, (*8409*).

MICROPORELLUS DEALBATUS (B. & C.) Murrill, Bull. Torrey Club 32: 483. 1905. *P. Adami* Berk. (type from Ceylon) and *P. rasipes* Berk. (type from the Admiralty Islands) do not appear to differ from this species.

Luzon: Mount Tapulao, Zambales Province, 1000–1400 m., *Curran & Merritt*, (*8203*). Mindanao: Camp Keithley, Lake Lanao, *Clemens.*

MICROPORELLUS SUBDEALBATUS Murrill, Bull. Torrey Club 34: 471. 1907.

Mindanao: Zamboanga, *Whitford & Hutchinson*, (*9226*).

NIGROPORUS DURUS (Jungh.) Murrill, Bull. Torrey Club 34: 471. 1907.

Luzon: Mauban, Tayabas Province, *Curran*, (*9588*); Santa Maria Mavitac, Laguna Province, *Curran*, (*8916*).

NIGROPORUS VINOSUS Murrill, Bull. Torrey Club 32: 361. 1905. *Polyporus badius* Jungh. and *Polystictus Möllerianus* Sacc. are not distinct from this species. Specimens in the Bresadola herbarium are erroneously labeled *Polyporus carneo-niger* Berk, and at Berlin *Polyporus badius* Berk.

Luzon: Bosoboso, Rizal Province, *Ramos*, (*2148*); Mt. Mariveles, Bataan Province, *Merrill*, (*3695*). Mindinao: Camp Keithley, Lake Lanao, *Clemens aa, h.*

POLYPORUS CELEBICUS P. Henn. Monsunia 1: 12. *pl. 1. f. 5.* 1899.

It is difficult to separate this species from *P. Perula* in some

of its forms, although typical examples are quite easily distinguished. Many mycologists do not consider *P. celebicus* distinct.

Luzon: Bosoboso, Rizal Province, *Ramos*, (*2154*), Rizal Province, *Ramos*, (*1861*); Santa Maria Mavitac, Laguna Province, *Curran*, (*8922*), (*8923*); Mt. Maquiling, Laguna Province, *Curran & Merritt*, (*8963*); Lamao River, Bataan Province, *Copeland 176*. Mindanao: Davao, *Copeland 489*; Trail to Mt. Apo, 1666 m., Davao, *Copeland 1066*; Camp Keithley, Lake Lanao, *Clemens bd, be*. Negros: Gimagaan River, *Copeland 6, 10*. Batanes: *Fénix*, (*3873*).

POLYPORUS CORACINUS, Murrill, Bull. Torrey Club **34**: 471. 1907.

Negros: Gimagaan River, *Copeland 18*.

POLYPORUS ELEGANS (Bull.) Fr. Epicr. Myc. 440. 1838.

Mindanao: Camp Keithley, Lake Lanao, *Clemens al.*

POLYPORUS FISSUS Berk. Lond. Jour. Bot. **6**: 318. 1847.

Luzon: Santa Maria Mavitac, Laguna Province, *Curran*, (*8914*).

POLYPORUS FLABELLIFORMIS Kl. Linnaea **8**: 483. 1833.

Luzon: Baguio, Benguet Province, *Elmer 6045*.

POLYPORUS GRAMMOCEPHALUS Berk. Lond. Jour. Bot. **1**: 148. 1842.

Negros: Gimagaan River, *Copeland 8*. Luzon: Lamao River, Bataan Province, *Copeland 160*, *Curran*, (*7531*); Mount Maquiling, Laguna Province, *Merrill*, (*5154*); Bosoboso, Rizal Province, *Ramos*, (*1858*), (*4622*); Sablan, Benguet Province, *Elmer 6185*. Balabac: *Mangubat*, (*532*). Mindanao, Camp Keithley, Lake Lamao, *Clemens am.*

POLYPORUS PALENSIS Murrill, Bull. Torrey Club **34**: 472. 1907.

Luzon: Sablan, Benguet Province, *Elmer 6184*; Lamao River, Bataan Province, *Copeland 153*. Negros: Gimagaan River, *Copeland 20*.

POLYPORUS PERULA (Beauv.) Fr. Epicr. 437. 1838. This species is very abundant and variable. One form of it (Luzon: Mount Maquiling, Laguna Province, *Curran & Merritt*, (*8965*)) is decidedly tomentose in appearance, with narrow glabrous zones such as occur in young specimens of *Coriolus versicolor*.

Luzon: Lamao River, 115 m., *Copeland E, 178;* Lamao River, Bataan Province, *Copeland 180;* Lamao Forest Reserve, Bataan Province, *Foxworthy*, (*1583*); Mt. Mariveles, 800 m., Bataan Province, *Copeland 183;* Benguet Province, *Elmer 6146;* Baguio, Benguet Province, *Elmer 5940, 6046;* Sablan, Benguet Province, *Elmer 6133, 6182;* Santa Maria Mavitac, Laguna Province, *Curran*, (*8924*), (*8925*); Mt. Maquiling, Laguna Province, *Merrill*, (*5152*), *Curran & Merritt*, (*8963*), (*8967*), (*8968*); Bosoboso, Rizal Province, *Ramos*, (*2147*), (*2152*); Montalban, Rizal Province, *Merrill*, (*5088*); Mt. Arayat, Pampanga Province, *Merrill*, (*5032*); Mt. Malaraya, Tayabas Province, *Curran & Merritt*, (*8943*), (*8961*); Batangas Province, *Curran & Merritt*, (*8937*); Mt. Tapulao, 1000–1400 m., Zambales Province, *Curran & Merritt*, (*8204*), (*8205*); Zambales Province, *Curran & Merritt*, (*8209*); Paete-Piapi, Tayabas and Laguna Provinces, *Curran*, (*9642*), (*9645*). Palawan: Victoria Peak, *Curran*, (*7485*), (*7486*), (*7487*). Batanes: *Fénix*, (*3878*), (*3882*), (*3886*). Balabac: *Mangubat*, (*530*). Mindoro: *Merritt*, (*8815*); Mt. Halcon, *Merrill*, (*6115*). Mindanao: Zamboanga, *Whitford & Hutchinson*, (*9236*); Catalonan, Davao, *Copeland 926;* Mt. Apo, 2000 m., Davao, *Copeland 1154;* Davao, *Copeland 151, 707;* Camp Keithley, Lake Lanao, *Clemens ab, ad, bh, ch, cj, "K," n, o, t, z.*

PYCNOPORUS SANGUINEUS (L.) Murrill, Bull. Torrey Club 31: 421. 1904.

Camiguin: Babuyanes, *Fénix*, (*4154*), (*4164*), (*4175*). Mindanao: Camp Keithley, Lake Lanao, *Clemens bc, ci;* Davao, *Copeland C.* Negros: Gimagaan River, *Copeland 3, 7.* Balabac: *Mangubat*, (*537*). Batanes: *Fénix*, (*3875*). Luzon: Pangisinan Province, *Ramos*, (*4980*); Montalban, Rizal Province, *Merrill*, (*5083*); Bosoboso, Rizal Province, *Ramos*, (*1199*), (*2155*); Manila, *Copeland 40;* Lamao, Bataan Province, *Curran*, (*7536*); Subig, Zambales Province, *Curran*, (*7021*), (*7022*); Santa Maria Mavitac, Laguna Province, *Curran*, (*8921*); Rizal Province, *Ramos*, (*1863*). Palmas: *Merrill*, (*5371*).

RIGIDOPORUS SURINAMENSIS (Miq.) Murrill, Bull. Torrey Club 34: 473. 1907.

Luzon: Mt. Maquiling, Laguna Province, *Curran & Merritt*,

(*8969*); Santa Maria Mavitac, Laguna Province, *Curran*, (*8917*). Mindanao: Camp Keithley, Lake Lanao, *Clemens ai.*

Trametes conglobata Murrill, sp. nov.

Pileus consisting of several lobes closely imbricated in a rounded sporophore 4 × 7 × 5 cm.; lobes rigid, convex above, plane below, dimidiate, 1–2 × 1–4 × 0.5–2 cm.; surface uneven, opaque, dirty white, subglabrous, anoderm, azonate; margin obtuse, undulate, concolorous: context white or pallid, multizonate, 0.4–1.5 cm. thick; tubes about 1 mm. long, dirty white, thin-walled, mouths angular, slightly irregular, 5–6 to a mm., edges entire to undulate: spores ovoid to subglobose, smooth, hyaline, 3–4 μ long; hyphae hyaline, 3 μ; cystidia none.

Type collected on deadwood at Camp Keithley, Lake Lanao, Mindanao, September–October, 1907, by Mary S. Clemens.

Trametes insularis Murrill, sp. nov.

Pileus sessile, dimidiate, imbricate, irregular, thickish behind, decurrent, 2–4 × 3–7 × 1–1.5 cm.; surface rugose, anoderm, glabrous, black behind, light reddish brown in front; margin obtuse, sterile, ochraceous, entire: context white to pallid, woody, zonate, 1.5–3 mm. thick; tubes 1 cm. long behind, becoming gradually shorter toward the margin, the section appearing triangular, concolorous with the context, mouths grayish-isabelline, subcircular, 3 to a mm., edges thick, firm, entire, becoming thinner at maturity: spores subglobose, smooth, hyaline, 4–5 μ long; hyphae hyaline, 3–4 μ; cystidia none.

Type collected on prostrate logs of *Pinus insularis* at Baguio, 1500 m., Benguet Province, Luzon, October–November, 1905, by E. D. Merrill, (*5001*).

TRAMETES MULLERI Berk. Jour. Linn. Soc. Bot. **10**: 320. 1868.

This species has the appearance and habit of *Daedalea*, but the tubes are never daedaleoid. *Trametes conchata* Berk., described from the Philippines, appears to be a variety of this species with sordid context and tubes, such as often occurs in *Daedalea amanitoides.*

Luzon: Zambales Province, *Curran*, (*7023*), (*7026*); Lamao River, Bataan Province, *Copeland 165*; Bosoboso, Rizal Province, *Curran*, (*9527*); Tarlac Province, *Merrill*, (*3602*). Camiguin: Babuyanes, *Fénix*, (*4176*). Mindanao: Camp Keithley, Lake Lanao, *Clemens an* and one other collection.

Tyromyces Merrittii Murrill, sp. nov.

Pileus imbricate-multiplex, the lobes few in number and attached together in a prolonged stipitiform base, each lobe flabelliform, with cuneate base, 7–9 × 7–9 × 0.5 cm.; surface radiate-rugose and roughened with prominences of various sizes, sordid white, opaque, very minutely tomentose; margin irregular, variously lobed, rather thick, fertile, slightly deflexed: context fleshy-fibrous, very brittle when dry, milk-white, 2 mm. thick; tubes 3 mm. long, slender, nearly white within, mouths grayish-white, glistening, discolored in places, regular, thin-walled, 3 to a mm., edges firm, entire: spores ovoid, curved, smooth, hyaline, 5–6 × 3 μ; hyphae very fragile, hyaline, 4–5 μ; cystidia none.

Type collected on dead wood on Mt. Maquiling, Batangas Province, Luzon, November, 1907, by H. M. Curran and M. L. Merritt, (*8939*).

Tyromyces subchioneus Murrill, sp. nov.

Pileus sessile, dimidiate, applanate, fleshy-tough to fragile, 2 × 4 × 0.2 cm.; surface smooth, glabrous, grayish isabelline, wrinkled when dry; margin entire, thin, sterile and abruptly deflexed: context white, homogeneous, fragile, 1 mm. thick when dry; tubes very distinct from the context in color, dark yellowish gray within, 1 mm. long, mouths subcircular, regular, grayish, glistening, 5–6 to a mm., edges entire, thick at first, becoming thinner at maturity: spores oblong, ellipsoid, smooth, hyaline, 5–6 × 2 μ; hyphae hyaline, 3–4 μ; cystidia none.

Type collected on dead wood on Mt. Apo, 2160 m., Davao, Mindanao, April 20, 1904, by E. B. Copeland, *1074*.

Tyromyces unguliformis Murrill, sp. nov.

Pileus compressed-ungulate, plane below, much thicker behind, 5 × 8 × 1–3 cm.; surface anoderm, azonate, somewhat tuberculose, nearly glabrous, milk-white, opaque; margin abruptly acute, narrowly sterile, concolorous, entire: context white, fragile when dry, homogeneous, 5–8 mm. thick; tubes white or yellowish within, 1 cm. long behind, gradually shorter towards the margin, slender, mouths circular, regular, 4 to a mm., somewhat glistening, white with a silvery sheen, edges thick, entire: spores smooth, ovoid, hyaline, 3 × 2 μ; hyphae hyaline, 3 μ; cystidia none.

Type collected on dead wood on Balabac Island, March–April, 1906, by L. Mangubat, (*533*).

Whitfordia Murrill, gen. nov.

Hymenophore annual, epixylous, stipitate; surface glabrous, anoderm: context brown, fibrous to corky; tubes minute, cylindrical: spores hyaline: stipe lateral, black.

Type species, *Fomes Warburgianus* P. Henn.

Whitfordia Warburgiana (P. Henn.) Murrill. *Fomes Warburgianus* P. Henn.; Monsunia 1: 10. *pl. 1. f. 3.* 1900. *Coriolopsis aneba* (Berk.) Murrill, Bull. Torrey Club 34: 466. 1907. Specimens sent in previously were too young and aborted to determine accurately. The context of this species is rather pale when young, becoming blacker with age.

Lumbacan: *Merrill*, (5280). Negros: Gimagaan River, *Copeland 12, 17.* Luzon: Mount Maquiling, Laguna Province, *Merrill*, (5150). Mindoro: Bongabong River, *Whitford 1436.* Mindanao: Sibulan River, Davao, *Copeland 1308;* Malita, Davao, *Copeland 655.*

Tribe FOMITEAE

Amauroderma asperulatum Murrill, sp. nov.

Pileus reniform to nearly circular, thick, corky, rigid, convexo-concave, 5 cm. in diameter, 1.5 cm. thick; surface glabrous, avellaneous with two or three dark brown zones, thinly encrusted, neither laccate nor shining, rugose when dry; margin thick, undulate, sulcate: context thin, 1–2 mm., white, punky-fibrous, homogeneous; tubes very long and slender, 1–1.5 cm., wood-brown, mouths angular, 3 to a mm., edges thin, entire: spores copious, ovoid, deep yellowish brown, averaging 18 × 12 μ, studded with immense warts: stipe ascending, laterally attached, cylindrical, equal, slightly expanding above, resembling the pileus in surface, harder in substance, 5 cm. long, 6–7 mm. thick.

Type collected on the base of dead *Parkia* (?), at Lamao, Bataan Province, Luzon, February 2, 1904, by E. B. Copeland.

Amauroderma bataanense Murrill, sp. nov.

Pileus circular in outline, nearly plane, rigid, corky, 5 × 5 × 0.5 cm.; surface much wrinkled both concentrically and radially in drying, sulcate, faintly zonate, opaque, avellaneous to grayish brown, paler toward the margin, thinly encrusted, glabrous; margin undulate, truncate; context white or nearly so, 3 mm. thick at the center, very thin at the margin, homogeneous, firm; tubes fuscous-brown within and without, 2–3 mm. long, mouths rather large and angular at maturity, 3 to a mm., edges thin, firm,

entire: spores globose, very deep brown, thick-walled, lightly asperulate, copious, 12–14 μ: stipe central, subcylindrical, enlarged at the surface of the ground, tapering and radicate below, corticated, isabelline, woody, 6 × 0.6 cm.

Type collected on decaying underground roots in the region of Lamao, Bataan Province, Luzon, September, 1907, by H. M. Curran, (*7528*).

Amauroderma Clemensiae Murrill, sp. nov.

Pileus thin, tough, flexible, flabelliform to subcircular, conchate, deeply depressed behind, 5 × 6 × 0.2–0.3 cm.; surface glabrous, nearly smooth, multizonate, faintly radiate-rugose when dry, brown behind, avellaneous in front, with darker zones; margin very thin, entire to undulate, blackish and inflexed on drying: context punky-fibrous, pale isabelline, 0.5–1.5 mm. thick; tubes 1.5–2.5 mm. long, pallid within, mouths avellaneous, umbrinous when bruised, regular, glistening 4–5 to a mm., edges thin, entire, corky: spores subglobose to ovoid, smooth, faint yellowish brown, copious, 5–7 μ: stipe exactly lateral, curved, cylindrical, nearly even, slightly enlarged at the base and somewhat compressed where it joins the pileus, resembling the pileus in surface and context, but uniformly light brown in color and almost woody, 8 × 0.6–0.7 cm.

Type collected on dead roots near Camp Keithley, Lake Lanao, Mindanao, September–October, 1907, by Mary S. Clemens.

AMAURODERMA ELMERIANUM Murrill, Bull. Torrey Club 34: 475. 1907.

Mindanao: Zamboanga, *Whitford & Hutchinson*, (*9288*).

Amauroderma Ramosii Murrill, sp. nov.

Pileus round-reniform, deeply incised at the hilum, where the stipe is attached, rigid, corky, slightly convex, 3 × 4 × 0.5 cm.; surface thinly encrusted, opaque, glabrous, very slightly sulcate-zonate, dark gray or blackish, much wrinkled on drying; margin thick, obliquely truncate, delicately penciled, undulate: context 1–2 mm. behind, very thin in front, nearly white, punky-fibrous; tubes 4–5 mm. long, slender, avellaneous, mouths concolorous or darker, regular, circular, 5 to a mm., edges very thick, entire: spores subglobose, finely asperulate, light yellowish brown, 8–10 μ: stipe laterally attached, suberect, curved and somewhat compressed, corticated, glabrous, paler than the pileus, woody, radicate and branched below, 7 × 0.4 cm.

Type collected on dead roots near Bosoboso, Rizal Province, Luzon, July, 1906, by Maximo Ramos, (*1211*).

ELFVINGIA ELMERI Murrill, Bull. Torrey Club 34: 476. 1907.

Luzon: Subig, Zambales Province, *Curran*, (*7024*). Mindanao: Camp Keithley, Lake Lanao, *Clemens ar* and one other collection.

ELFVINGIA TORNATA (Pers.) Murrill, Bull. Torrey Club 30: 301. 1903. *Ganoderma subtornatum* Murrill is probably only a form of this species having an excess of resin. The two genera come very close together here.

Mindanao: Davao, Copeland *380, 500;* Todaya, Davao, 1400 m., *Copeland*, 900 m., *Copeland 1223;* Camp Keithley, Lake Lanao, *Clemens i, y*, and one other collection. Luzon: Mount Maquiling, Laguna Province, *Merrill*, (*5155*); Bosoboso, Rizal Province, *Ramos*, (*1193*), (*1209*), (*1216*); Mt. Mariveles, *Copeland 167, 190;* Mt. Malaraya, Tayabas Province, *Curran & Merritt*, (*8944*); Zambales Province, *Curran & Merritt*, (*8203*); Rizal Province, *Foxworthy*, (*137*); Montalban, Rizal Province, *Merrill*, (*5087*); Lamao Forest Reserve, Bataan Province, *Curran*, (*7387*); Panai, Benguet Province, *Elmer*, (*5002*); Lamao River, Bataan Province, *Copeland 181, 189, 193;* Baguio, Benguet Province, *Elmer 6069;* Santa Maria Mavitac, Laguna Province, *Curran*, (8932). Balabac: *Mangubat*, (*536*). Camiguin: Babuyanes, *Finix*, (*4169*), (*4173*), (*4178*). Palmas: *Merrill*, (*5370*).

FOMES AUBERIANUS (Mont.) Murrill, Bull. Torrey Club 32: 491. 1905.

Mindanao: Camp Keithley, Lake Lanao, *Clemens au, bg*, and one other collection. Negros: Gimagaan River, *Copeland 13*.

FOMES LIGNEUS (Berk.) Cooke, Grevillea 13: 119. 1884.

Mindanao: Camp Keithley, Lake Lanao, *Clemens "Q"*.

FOMES LUZONENSIS Murrill, Bull. Torrey Club 34: 476. 1907.

Luzon: Mt. Mariveles, Bataan Province, *Copeland 182*, on living *Dipterocarpus*. These specimens are too young to show typical surface markings or a stratified hymenium.

FOMES UNGULATUS (Schaeff.) Sacc. Syll. Fung. 6: 167. 1888.

Luzon: Baguio, Benguet Province, *Elmer 5945*. No. 5238 (Luzon: Baguio, Benguet Province, *Curran*) appears to be a young and much discolored specimen of this species.

Fomes subresinosus Murrill, sp. nov.

Pileus semicampanulate, attached by an elongated umbo, concave below, woody, 6 × 8 × 1 cm.; surface glabrous, somewhat resinous, thinly encrusted, very rugose when dry, slightly sulcate, conspicuously banded with broad brown and shining-black zones; margin thick, abruptly acute and deflexed, entire or undulate, concolorous: context white, slightly pallid when dry, woody-fibrous, 3–5 mm. thick; tubes 5–8 mm. long, slender, brownish flesh-colored within when dry, mouths circular and whitish when young, becoming angular and concolorous at maturity, 3–4 to a mm., edges at first thick, becoming thin and lacerate: spores globose or subglobose, smooth, hyaline, 3–4 μ; hyphae hyaline; cystidia none.

Type collected on dead wood in the Lamao Forest Reserve, Bataan Province, Luzon, October, 1906, by F. W. Foxworthy, (*1628*). Also collected at Bosoboso, Rizal Province, Luzon, July, 1906, by Maximo Ramos, (*1215*).

Fomes subungulatus Murrill, sp. nov.

Pileus sessile, dimidiate, broadly attached, the point of attachment bounded by a narrow black zone, rigid, convex above, concave below, 6 × 8 × 1–2 cm.; surface sulcate, glabrous, anodermic, slightly tuberculose, isabelline, suffused in places with reddish brown; margin rounded, thick, entire: context thick, 5–8 mm., isabelline, zonate, soft-corky; tubes whitish within, slender, 3–5 mm. long, not distinctly stratified, mouths small, white to isabelline, perfectly circular, 5 to a mm., edges thick, obtuse, entire: spores ovoid, smooth, hyaline, 5 × 3.5 μ; hyphae hyaline, 5–6 μ: cystidia none.

Type collected on prostrate logs of *Pinus insularis* at Baguio, 1500 m., Benguet Province, Luzon, October–November, 1905, by E. D. Merrill, (*5005*).

GANODERMA AMBOINENSE (Lam.) Pat. Bull. Soc. Myc. Fr. **5**: 70. 1889.

Luzon: Lamao Forest Reserve, Bataan Province, *Curran*, (*7395*); Lamao, Bataan Province, *Copeland 1365*; Bosoboso, Rizal Province, *Ramos*, (*2157*). Negros: Gimagaan River, *Copeland 16*.

Ganoderma balabacense Murrill, sp. nov.

Pileus ascending from a short, thick tubercle, flabelliform to nearly circular, depressed at the center or behind, very concave below, 15 × 15 × 2 cm.; surface glabrous, thinly encrusted,

opaque brown behind, laccate, shining and dark reddish brown in front, rugose and roughly tuberculose, sulcate; margin abruptly acute, yellowish, sterile, entire: context ferruginous above, fulvous below, woody-fibrous, 1 cm. thick; tubes cinereous-fuscous, slender, 1 cm. long, mouths circular, regular, 3–4 to a mm., whitish when young, concolorous at maturity, edges thick, entire: spores ovoid, finely asperulate, pale brownish, 8–9 × 4–5 μ; hyphae ferruginous-fulvous; cystidia none.

Type collected on the island of Balabac, March–April, 1906, by L. Mangubat, (*539*).

Ganoderma Currani Murrill, sp. nov.

Pileus corky, rigid, reniform, convex above, concave below, slightly depressed behind, attached at the hilum to a very long stipe, 3–4 × 5–6 × 0.5 cm.; surface glabrous, laccate, shining, reddish brown, shallowly concentrically sulcate, radiate-rugose; margin thick, undulate, concolorous: context fulvous, punky, 1–2 mm. thick; tubes slender, 3–4 mm. long at the thickest part of the pileus, grayish fuscous, mouths becoming concolorous, circular to angular, 4–5 to a mm.: spores ovoid, distinctly asperulate, deep fulvous, copious, 8–10 × 6–7 μ: stipe erect, sublaterally attached, nearly cylindrical, slightly irregular, equal, laccate, glabrous, encrusted, 15–20 cm. long, 5–10 mm. thick.

Type collected on dead wood at Lamao, Bataan Province, Luzon, September, 1907, by H. M. Curran, (*7544*).

NIGROFOMES MELANOPORUS (Mont.) Murrill, Bull. Torrey Club **31**: 425. 1904.

Luzon: Lamao, Bataan Province, *Curran*, (*7540*).

PYROPOLYPORUS ALBOMARGINATUS (Lév.) Murrill, Bull. Torrey Club **34**: 478. 1907. *Polyporus ochrocroceus* P. Henn. (Monsunia **1**: 145. 1899.) exactly corresponds to this species, judging from the description, and should be treated as a synonym.

Luzon: Bosoboso, Rizal Province, *Ramos*, (*2149*), (*2150*), (*2156*); Lamao River, Bataan Province, *Copeland 173*; Mt. Mariveles, Bataan Province, *Merrill*, (*3698*). Mindanao: Mt. Apo, Davao, *Copeland 1077*. A specimen collected at Camp Keithley by Mrs. Clemens agrees well with *Fomes pyrrhocreas* Cooke, which I have considered synonymous with *P. albomarginatus*. It may be that further collections will prove them distinct species.

PYROPOLYPORUS CALIGINOSUS (Berk.) Murrill, Bull. Torrey Club 34: 478. 1907.

Mindanao: Camp Keithley, Lake Lanao, *Clemens ak, d, f.*

PYROPOLYPORUS ENDOTHEIUS (Berk.) Murrill, Bull. Torrey Club 34: 478. 1907. *Pyropolyporus Williamsii* Murrill, Bull. Torrey Club 34: 479. 1907. A quantity of good material shows gradations between the two forms distinguished as species in a former paper. When young the context is bright-colored, becoming darker and thinner with age.

Mindoro: Mt. Halcon, *Merrill*, (*6120*). Camiguin: Babuyanes, *Fénix*, (*4177*). Mindanao: Camp Keithley, Lake Lanao, *Clemens cf*, and one other collection. Luzon: Montalban, Rizal Province, *Merrill*, (*5089*); Bosoboso, Rizal Province, *Curran*, (*9526*); Mt. Malaraya, Tayabas Province, *Curran & Merritt*, (*8950*).

PYROPOLYPORUS FASTUOSUS (Lév.) Murrill, Bull. Torrey Club 34: 479. 1907.

Mindoro: Mt. Halcon, *Merrill*, (*6114*). Luzon: Antipolo, Rizal Province, *Curran*, (*7044*). Camiguin: Babuyanes, *Fénix*, (*4171*). Mindanao: Zamboanga, *Whitford & Hutchinson*, (*8942*); Camp Keithley, Lake Lanao, *Clemens bi, p, u, x.*

PYROPOLYPORUS LAMAENSIS Murrill, Bull. Torrey Club 34: 479. 1907.

Luzon: Mt. Mariveles, Bataan Province, *Copeland 145*. Negros: Gimagaan River, *Copeland 15*. Mindanao: Catalonan, Davao, *Copeland 922.*

PYROPOLYPORUS PECTINATUS (Kl.) Murrill, Bull. Torrey Club 34: 479. 1907. *Fomes substygius* B. & Br., from Ceylon, is considerably larger than the usual form of this species, but it does not appear to be specifically distinct. *Polyporus Hasskarlii* Lév., described from Java in 1844, is identical with Klotsch's species described from the East Indies eleven years previously.

Luzon: Santa Maria Mavitac, Laguna Province, *Curran*, (*8912*); Lamao, Bataan Province, *Curran*, (*7520*). Palawan: Ewiig River, *Merrill*, (*3586*).

Pyropolyporus subextensus Murrill, sp. nov.

Pileus large, woody, sessile, dimidiate, applanate, slightly convex below, 7–8 × 10–12 × 1 cm.; surface rough, slightly sulcate, glabrous, thinly encrusted, opaque brown; margin slightly lobed, very obtuse, fulvous, sterile: context ferruginous, multizonate, woody, nearly 1 cm. thick; tubes short, 1–2 mm. long each season, fulvous in older layers, grayish fuscous in those of recent growth, mouths minute, fulvous, circular, thick-walled, 7–8 to a mm., edges thick, entire: hyphae ferruginous, 3–4 μ; cystidia flask-shaped or irregular in outline, pointed, fulvous, very abundant, 15–30 μ long, 8–10 μ thick at the base.

Type collected on dead wood at Camp Keithley, Lake Lanao, Mindanao, September, 1907, by Mary S. Clemens. Also collected on Mt. Apo, 2000 m., Davao, Mindanao, April 22, 1904, by E. B. Copeland, "*E.*"

Pyropolyporus tenuissimus Murrill, sp. nov.

Pileus thin, woody, rigid, dimidiate, concave above, convex below, decurrent behind, 1–1.5 × 4–5 × 0.1–0.2 cm.; surface rough, spongy-tomentose to subglabrous, neither sulcate nor zonate, fulvous to fuliginous, thicker and more spongy near the margin, which is fulvous, finely tomentose, rather thick, undulate: context fulvous, very thin, punky to corky; tubes stratified, 0.5 mm. or less long each season, cinereous-fuscous within, mouths whitish-stuffed when young, minute, 6 to a mm., circular, regular, avellaneous at first, becoming darker at maturity, edges thick, entire: spores globose, smooth, hyaline, copious, 3–4 μ; hyphae melleous, 2–3 μ; cystidia fulvous, cuspidate, scanty, 15–20 μ long, 5–7 μ thick at the base.

Type collected on dead wood in Davao, Mindanao, March 13, 1904, by E. B. Copeland, *497*.

Pyropolyporus tricolor Murrill, sp. nov.

Pileus very large, applanate, comparatively thin, rigid, woody, 15 × 25 × 1–2 cm.; surface roughly tuberculose and ridged, irregularly sulcate, thinly encrusted, glabrous, dark brown to dull black, rimose in dried specimens; margin thin, obtuse, reddish, subentire: context woody, brick-red, with white dendroid markings, 5–8 mm. thick; tubes 4–5 mm. long each season, brick-red in the older layers, yellowish red with white lines in recent growths, mouths minute, regular, circular, glistening, melleous, 4 to a mm., edges rather thick, entire: spores subglobose, smooth, hyaline, with smoky brownish, rather thin walls, 5–6 μ; hyphae melleous, 3–4 μ; cystidia none.

Type collected on dead wood at Santa Maria Mavitac, Laguna Province, Luzon, February, 1908, by H. M. Curran, (*8933*).

Tribe DAEDALEAE

CYCLOMYCES FUSCUS Fr. Linnaea **5**: 512. *pl. 11. f. 3.* 1830.
(Type from Mauritius.)

Luzon: Mt. Malaraya, Tayabas Province, *Curran & Merritt*, (*8949*); Benguet Province, *Elmer 6048*.

DAEDALEA AMANITOIDES Beauv. Fl. Owar. 1: 44. 1805.

Luzon: Mt. Malaraya, Tayabas Province, *Curran & Merritt*, (*8945*), (*8953*); Bosoboso; Rizal Province, *Ramos*, (*1191*), (*1207*), (*4619*), (*4623*); Rizal Province, *Ramos*, (*1867*); Bagac, Bataan Province, *Curran*, (*6494*); Lamao Forest Reserve, Bataan Province, (*7389*); Lamao, Bataan Province, *Curran*, (*7542*); Panai, Benguet Province, *Merrill*, (*5004*); Montalban, Rizal Province, *Merrill*, (*5091*); Twin Peaks, Benguet Province, *Elmer 6354*. Negros: Gimagaan River, *Copeland 21*. Mindoro: Bongabong River, *Whitford 1443*. Mindanao: Davao, *Copeland 490*; Camp Keithley, Lake Lanao, *Clemens g, m*, and one other collection.

DAEDALEA HOBSONI Berk. Jour. Linn. Soc. Bot. **13**: 165. 1873.

Balabac: *Mangubat*, (*510*). Luzon: Bagac, Bataan Province, *Curran*, (*6493*); Montalban, Rizal Province, *Merrill*, (*5084*); Moron, Bataan Province, *Curran*, (*6492*); Lamao, Bataan Province, *Copeland 186, 187, 188*; Bauang, Union Province, *Elmer 5745*; Santa Maria Mavitac, Laguna Province, *Curran*, (*8920*), (*8931*); Cavite Province, *Curran & Merritt*, (*8941*); Zambales Province, *Curran*, (*7027*); Mt. Mariveles, Bataan Province, *Merrill*, (*3696*); Rizal Province, *Foxworthy*, (*119*), *Ramos*, (*1868*); Antipolo, Rizal Province, *Curran*, (*7041*); Manila, *Copeland 42*. Mindoro: Bongabong River, *Whitford 1419*. Mindanao: Zamboanga, *Whitford & Hutchinson*, (*9225*); Camp Keithley, Lake Lanao, *Clemens "O," q*.

Daedalea isabellina Murrill, sp. nov.

Pileus thin, corky, slightly flexible, sessile, dimidiate, applanate above, convex below, thickest behind, 5 × 9 × 0.5–1.5 cm.; surface glabrous, faintly multizonate in front, rough and warty behind, somewhat radiate-rugose, isabelline; margin thin, un-

dulate, subconcolorous: context homogeneous, corky, isabelline, 1–2 mm. thick; hymenium very irregular, porose-daedaleoid behind and lamellate nearly to the margin, where the furrows are forked or additional ones inserted and the edges are thick and close; furrows mostly radial, thin-walled, 1–1.5 mm. wide, 1.3 cm. deep behind, becoming gradually shallower towards the margin, edges entire or undulate, some of them splitting into broad, flat plates with sharply toothed lower margins: spores ovoid, smooth, hyaline, copious, 5–6 × 3–4 μ; hyphae slightly yellowish, 3–4 μ; cystidia none.

Type collected on dead wood at Sablan, Benguet Province, Luzon, April, 1904, by A. D. E. Elmer, *6186*.

Daedalea subconfragosa Murrill, sp. nov.

Pileus sessile, reniform, thin, flexible, conchate, 6 × 11 × 0.3 cm.; surface glabrous, faintly multizonate, pale wood-color; margin acute, fertile, concolorous, entire or undulate: context ochraceous, punky, less than 1 mm. thick; tubes pale wood-color within and without, 2–3 mm. long, tough, mouths much elongated radially, variable in size, 1–6 × 0.5–1 mm., edges thin, undulate or irregularly toothed: spores ellipsoidal, smooth, hyaline, 5–6 × 3–4 μ; hyphae hyaline, 3–4 μ; cystidia none.

Type collected on dead wood in Rizal Province, Luzon, January, 1906, by F. W. Foxworthy, (*22*).

GLOEOPHYLLUM EDULE Murrill, Bull. Torrey Club **34**: 480. 1907.

Luzon: Baguio, Benguet Province, *Elmer*, *Merrill*, (*5000*); Trinidad, Benguet Province, *Elmer 5942*; Zambales Province, *Curran*, (*7019*).

Gloeophyllum nigrozonatum Murrill, sp. nov.

Pileus rigid, subtriangular, narrower behind, sessile, convex above, plane below, 7 × 6 × 1–2 cm.; surface glabrous, nearly smooth, cinereous behind, isabelline in front, with a broad black zone one third the distance from the point of attachment and two or three indistinct brownish zones near the margin, which is thick, rounded, sterile, faintly tomentose, subentire, isabelline or slightly avellaneous: context ferruginous, corky, homogeneous, 5 mm. thick; tubes 1 mm. long behind and at the center, avellaneous, with fulvous dissepiments, mouths ferruginous to cinereous-fuscous, very uneven and irregular in size and shape, daedaleoid and 1–2 × 2–5 mm. behind, with irpiciform edges, poroid and 1 mm. or less at the margin, with edges entire: spores ovoid, smooth, hyaline, scanty, 5 × 3.5 μ; hyphae ferruginous, 3 μ; cystidia none.

Type collected on dead wood near Baguio, Benguet Province, Luzon, March, 1904, by A. D. E. Elmer, *5941*.

GLOEOPHYLLUM STRIATUM (Sw.) Murrill, Bull. Torrey Club 32: 370. 1905.

Mindanao: Davao, *Copeland D, 525*. Negros: Gimagaan River, *Copeland*.

Lenzites Clemensiae Murrill, sp. nov.

Pileus flabelliform, applanate above, convex below, very slightly flexible, tapering to a very small point of attachment behind, 6 × 7 × 1–1.5 cm.; surface marked with a few broad concentric furrows, minutely reticulated, pure white and regularly radiate-grooved on the marginal band 1.5 cm. broad, grayish-discolored and almost devoid of reticulations and grooves behind; margin subentire, very thick, the context projecting so as to form a very slight edge above the rounded ends of the gills: context milk-white, 1 mm. thick; furrows very deep, reaching 1 cm. or more, most of them forked once, 2 mm. broad, dissepiments entire, obtuse, firm, slightly cremeous.

Type collected on dead wood at Camp Keithley, Lake Lanao, Mindanao, September, 1907, by Mary S. Clemens, *cc*.

Lenzites submurina Murrill, sp. nov.

Pileus thin, tough, slightly flexible, dimidiate, sessile, applanate above and below, 5 × 9 × 1 cm.; surface glabrous, narrowly sulcate and avellaneous-isabelline in front, broadly sulcate and murinous behind; margin thin, undulate: context white, very distinct in color from the isabelline dissepiments, very thin at the margin, increasing to 3 mm. thick behind; furrows lamellate, 1 mm. wide, reaching 5 mm. in depth, edges entire or slightly undulate, not splitting with age.

Type collected on dead wood at Camp Keithley, Lake Lanao, Mindanao, September–October, 1907, by Mary S. Clemens, *aj*.

NEW YORK BOTANICAL GARDEN.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1908)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

This Index is reprinted monthly on cards, and furnished in this form to subscribers, at the rate of one cent for each card. Selections of cards are not permitted; each subscriber must take all cards published during the term of his subscription. Correspondence relating to the card-issue should be addressed to the Treasurer of the Torrey Botanical Club.

Bacon, A. E. Prof. Alphonso Wood. Bull. Vermont Bot. Club **3**: 21–26. Ap 1908.

Bailey, W. W. A forgotten botanical garden. Am. Bot. **14**: 41–43. [Jl] 1908.

Benson, M. On the contents of the pollen chamber of a specimen of *Lagenostoma ovoides*. Bot. Gaz. **45**: 409–412. *f. 1, 2.* 27 Je 1908.

Borgesen, F. The *Dasycladaceae* of the Danish West Indies. Bot. Tidsskr. **28**: 271–283. *f. 1–9.* 22 My 1908.

Bourn, A. The Botrychiums of Dorset, Vermont. Bull. Vermont Bot. Club **3**: 17. Ap 1908.

Britton, E. G. The genus *Zygodon* in North America. Bryologist **11**: 61–66. Jl 1908. [Illust.]

Britton, N. L. Botanical exploration in Jamaica. Jour. N. Y. Bot. Gard. **9**: 81–90. My 1908.

Britton, N. L. The generic name *Bucida*. Bull. Torrey Club **35**: 303, 304. *f. 1.* 1 Jl 1908.

Burlingham, G. S. A study of the *Lactariae* of the United States. Mem. Torrey Club **14**: 1–109. *f. 1–15.* 26 My 1908.

Campbell, D. H. The prothallium of *Kaulfussia* and *Gleichenia*. Ann. Jard. Bot. Buitenzorg II. **7**: 69–102. *pl. 7–14.* Je 1908.

Clute, W. N. A remarkable change of color in *Trillium*. Am. Bot. **14**: 33–35. [Jl] 1908. [Illust.]

[Coker, W. C.] Chapel Hill ferns and their allies. Jour. Elisha Mitchell Soc. **23**: 134–136. [Je] 1908.

Cook, M. T. The hypertrophied fruit of *Bucida Buceras*. Bull. Torrey Club **35**: 305, 306. *f. 1, 2.* 1 Jl 1908.

Coulter, J. M. Relation of megaspores to embyro-sacs in angiosperms. Bot. Gaz. **45**: 361–366. 27 Je 1908.

Crawford, A. C. Notes on "physiological resting." Am. Jour. Pharm. **80**: 321–335. Jl 1908.

Dobbin, F. By the pondside. Am. Bot. **14**: 38–40. [Jl] 1908.

Dorety, H. A. The embryo of *Ceratozamia*: a physiological study. Bot. Gaz. **45**: 412–416. *f. 1–7.* 27 Je 1908.

Dutton, D. L. Some rare plants on Mount Horrid. Bull. Vermont Bot. Club **3**: 38, 39. Ap 1908.

Edgerton, C. W. The physiology and development of some anthracnoses. Bot. Gaz. **45**: 367–408. *pl. 11* + *f. 1–17.* Je 1908.

Edson, H. A. Soil reaction in relation to flora. Bull. Vermont Bot. Club **3**: 34–36. Ap 1908.

Eggleston, W. W. A trip to Mount Mitchell. Bull. Vermont Bot. Club **3**: 40–42. Ap 1908.

Evans, A. W. The synonymy of three American *Hepaticae*. Bryologist **11**: 67–70. Jl 1908.

Fletcher, J. Two newly introduced European plants. Ottawa Nat. **22**: 80, 81. 10 Jl 1908.

French, G. T. Observations on *Medicago lupulina* L. Science II. 28: 127. 24 Jl 1908.

Gager, C. S. Teratological notes. Torreya **8**: 132–137. 30 Je 1908. [Illust.]

Gates, F. C. Comparison of the seasons at Chicago and Urbana, Illinois. Am. Bot. **14**: 45, 46. [Jl] 1908.

Gleason, H. A. Resting plants. Am. Bot. **14**: 35–38. [Jl] 1908.

Gürke, M. Die Gattung *Peireskiopsis* Britt. et Rose. (*Opuntia* subgen. *Peireskiopuntia* Web.) Monats. Kakteenk. **18**: 81–84. 15 Je 1908.

Gürke, M. Neue Kakteen-Arten aus Brasilien. Monats. Kakteenk. **18**: 84–89. [Illust.] 15 Je 1908.
New species in *Cereus*, *Cephalocereus* [2] and *Peireskia*.

Gürke, M. *Melocactus Maxonii* (Rose) Gürke. Monats. Kakteenk. 18: 93. 15 Je 1908.

Harshberger, J. W. The comparative leaf structure of the sand dune plants of Bermuda. Proc. Am. Phil. Soc. **47**: 97–109. *pl. 1–3.*

Hazen, T. E. *Oxalis Brittoniae* at Pownal. Bull. Vermont Bot. Club **3**: 17, 18. Ap 1908.

Hemsley, [W. B.] *Philadelphus madrensis.* Kew Bull. Misc. Inf. 1908: 251.

New species from Mexico.

Hitchcock, A. S. Types of American grasses: a study of the American species of grasses described by Linnaeus, Gronovius, Sloane, Swartz, and Michaux. Contr. U. S. Nat. Herb. **12**: 113–158. 18 Je 1908.

Brachiaria Meziana sp. nov., described in a footnote.

Iorns, M. J. Observations on change of sex in *Carica Papaya.* Science II. **28**: 125, 126. 24 Jl 1908.

Johnston, J. R. A collection of plants from the vicinity of La Guaira, Venezuela. Contr. U. S. Nat. Herb. **12**: 105–111. 20 My 1908.

Includes description of five new species.

Kennedy, P. B. Further notes regarding *Dicoria.* Muhlenbergia 4: 38–40. 3 Je 1908.

Matton, W. R. The sprouting of short-leaf pine in the Arkansas National Forest. Forestry Quart. **6**: 158, 159. Je 1908.

McClendon, J. F. On xerophytic adaptations of leaf structures in yuccas, agaves, and nolinas. Am. Nat. **42**: 308–316. *f. 1–25.* 7 Je 1908.

Mildbraed, J. *Stylidiaceae.* Das Pflanzenreich 4^{278}: 1–98. *f. 1–26.* 26 My 1908.

Includes notes on *Donatia* from Chili.

Moore, G. T. The most primitive living representative of the ancestors of the plant kingdom. Proc. Am. Phil. Soc. **47**: 91–96. 1908.

Murrill, W. A. The chestnut canker. Torreya **8**: 111, 112. 19 My 1908.

Murrill, W. A. A key to the white and bright-colored sessile Polyporeae of temperate North America—III. Torreya **8**: 130–132. 30 Je 1908.

Murrill, W. A. Leaf blight of the plane-tree. Jour. N. Y. Bot. Gard. **9**: 105–107. *pl. 45 + f. 13.* Je 1908.

Nash, G. V. The lace-bark tree. Jour. N. Y. Bot. Gard. **9**: 116-118. *f. 14–16.* Je 1908.

Nash, G. V. Two new grasses from the West Indies. Bull. Torrey Club **35**: 301, 302. 1 Jl 1908.
Panicum Grisebachii and *Pharus parvifolius* spp. nov.

Osterhout, W. J. V. The value of sodium to plants by reason of its protective action. Univ. California Pub. Bot. **3**: 331–337. 26 Je 1908.

Osterhout, W. J. V. On the effects of certain poisonous gases on plants. Univ. California Pub. Bot. **3**: 339, 340. 26 Je 1908.

Paris, E. G. Note sur le *Hookeria papillata* Sull. (nec Mont. !). Rev. Bryol. **35**: 61. 1908.

Parish, S. B. A problem of plant distribution. Muhlenbergia **4**: 42, 43. 3 Je 1908.

Patouillard, N. Champignons noveaux ou peu connus. Bull. Soc. Myc. **24**: 1–12. *f. 1–3.* 20 Mr 1908.
Includes 15 American species described as new.

Penhallow, D. P. Some fossil plants from the middle Devonian of Milwaukee, Wisconsin. Bull. Wisconsin Nat. Hist. Soc. **6**: 8–12. *pl. 1, 2.* Ap 1908.
Nematophycus milwaukeensis and *Fucus bertheletensis* spp. nov.

Penhallow, D. P. Report on a collection of fossil woods from the Cretaceous of Alberta. Ottawa Nat. **22**: 82–85. *f. 1–6.* 10 Je 1908.
Picea albertensis and *Sequoia albertensis* spp. nov.

Pilger, R. Eine neue Gattung der Aizoaceae. Bot. Jahrb. **40**: 396, 397. 24 Ja 1908. [Illust.]
Glischrothammus Ulei gen. et sp. nov. from Brazil.

Pittier de Fábrega, H. *Tonduzia*, a new genus of *Apocynaceae* from Central America. Contr. U. S. Nat. Herb. **12**: 103, 104. *pl. 9* + *f. 5, 6.* 20 My 1908.
T. parvifolia Pittier sp. nov. and *T. stenophylla* (Donnell Smith) Pittier, comb. nov.

Pittier de Fábrega, H. The *Lecythidaceae* of Costa Rica. Contr. U. S. Nat. Herb. **12**: 95–101. *pl. 1–8.* 20 My 1908.
Includes several new species.

Quehl, L. *Mamillaria difficilis* Quehl n. sp. Monats. Kakteenk. **18**: 107. 15 Jl 1908. [Illust.]
From Mexico.

Quehl, L. *Mamillaria Eichlamii* Quehl n. sp. Monats. Kakteenk. **18**: 65, 66. 15 My 1908.
From Guatemala.

Quehl, L. *Mamillaria Joossensiana* Quehl n. sp. Monats. Kakteenk. **18**: 95. 15 Je 1908.
From Mexico.

Reynolds, E. S. Plant pathology in its relation to other sciences. Science II. **27**: 937–940. 19 Je 1908.

Robinson, B. L. Further notes on the vascular plants of the northeastern United States. Rhodora **10**: 64–67. 16 My 1908.

[Rolfe, R. A.] *Epidendrum pentotis.* Orchid Rev. **16**: 189. Je 1908.

Rothrock, J. T. Hackberry, sugar-berry (*Celtis occidentalis* L.). Forest Leaves **11**: 136, 137. Je 1908. [Illust.]

Ruggles, B. P. Hartland sedges. Bull. Vermont Bot. Club **3**: 43–45. Ap 1908.

Rusby, H. H. Adulterants in foods and drugs and their detection. Jour. N. Y. Bot. Gard. **9**: 107–115. Je 1908.

Saunders, C. F. Rediscovery of *Cheilanthes Parishii.* Fern Bull. **16**: 35: [Je] 1908.

Seaton, S. The development of the embryo-sac of *Nymphaea advena.* Bull. Torrey Club **35**: 283–290. *pl. 18, 19.* 1 Jl 1908.

Seaver, F. J. Color variation in some of the fungi. Bull. Torrey Club **35**: 307–314. 1 Jl 1908.

Servettaz, C. Note préliminaire sur la systématique des Elaeagnacées. Bull. Herb. Boiss. II. **8**: 381–394. 30 My 1908.

Setchell, W. A. Notes on *Lycoperdon sculptum* Harkness. Bull. Torrey Club **35**: 291–296. *pl. 20.* 1 Jl 1908.

Setchell, W. A. Critical notes on *Laminariaceae.* Nuov. Notar. **19**: 90–101. Ap 1908.

Sheldon, J. L. Another leaf-spot fungus of the apple. Torreya **8**: 139–141. 30 Je 1908.
Illosporium malifoliorum sp. nov.

Shepard, J. Solar prints of plants. Fern Bull. **16**: 39–42. [Je] 1908. [Illust.]

Smith, R. W. Endosperm of *Pontederiaceae.* Bot. Gaz. **45**: 338, 339. *f. 1–4.* 15 My 1908.

Spillman, W. J. An interpretation of elementary species. Science II. **27**: 896–898. 5 Je 1908.

Sprague, [T. A.]. *Begonia dichroa.* Kew Bull. Misc. Inf. **1908**: 251, 252. 1908.
New species from Brazil.

Sprague, [T. A.]. & Hutchinson, [R. R.]. *Sanchesia parvibracteata.* Kew Bull. Misc. Inf. **1908**: 253, 254. 1908.
New species from Brazil.

Sprague, [T. A.]. *Asterophorum eburneum.* Kew Bull. Misc. Inf. **1908**: 249, 250.
New genus and species from Ecuador.

Sterling, C. M. Histology of *Hyoscyamus muticus.* Am. Jour. Pharm. **80**: 361–368. *f. 1–5.* Au 1908.

Sydow, H. & P. Über eine Anzahl aus der Gattung *Uromyces* auszuschliessender resp. unrichtig beschriebener Arten. Ann. Myc. **6**: 135–143. 31 My 1908.

Theissen, F. Über die Berechtigung der Gattung *Diatrypeopsis* Speg. Ann. Myc. **6**: 91–94. 31 My 1908.

Tilden, J. E. Notes on a collection of algae from Guatemala. Proc. Biol. Soc. Washington **21**: 153–156. 9 Je 1908.

Trundy, A. H. Fairy rings of *Lycopodium sabinaefolium* in Maine. Fern Bull. **15**: 70, 71. [Je] 1908.

Ule, E. Über eine neue Gattung der Capparidaceen mit Klettervorrichtungen. Ber. Deuts. Bot. Gesells. **26a**: 220–224. 23 Ap 1908.
Haptocarpum bahiense gen. et sp. nov. from Brazil.

Urban, I. Nova genera et species — III. Symb. Antill. **5**: 353–555. 20 My 1908.
Includes many new West Indian species.

Weingart, W. *Cereus flagelliformis* var. *minor* Salm-Dyck. Monats. Kakteenk. **18**: 49–52. 15 Ap 1908.

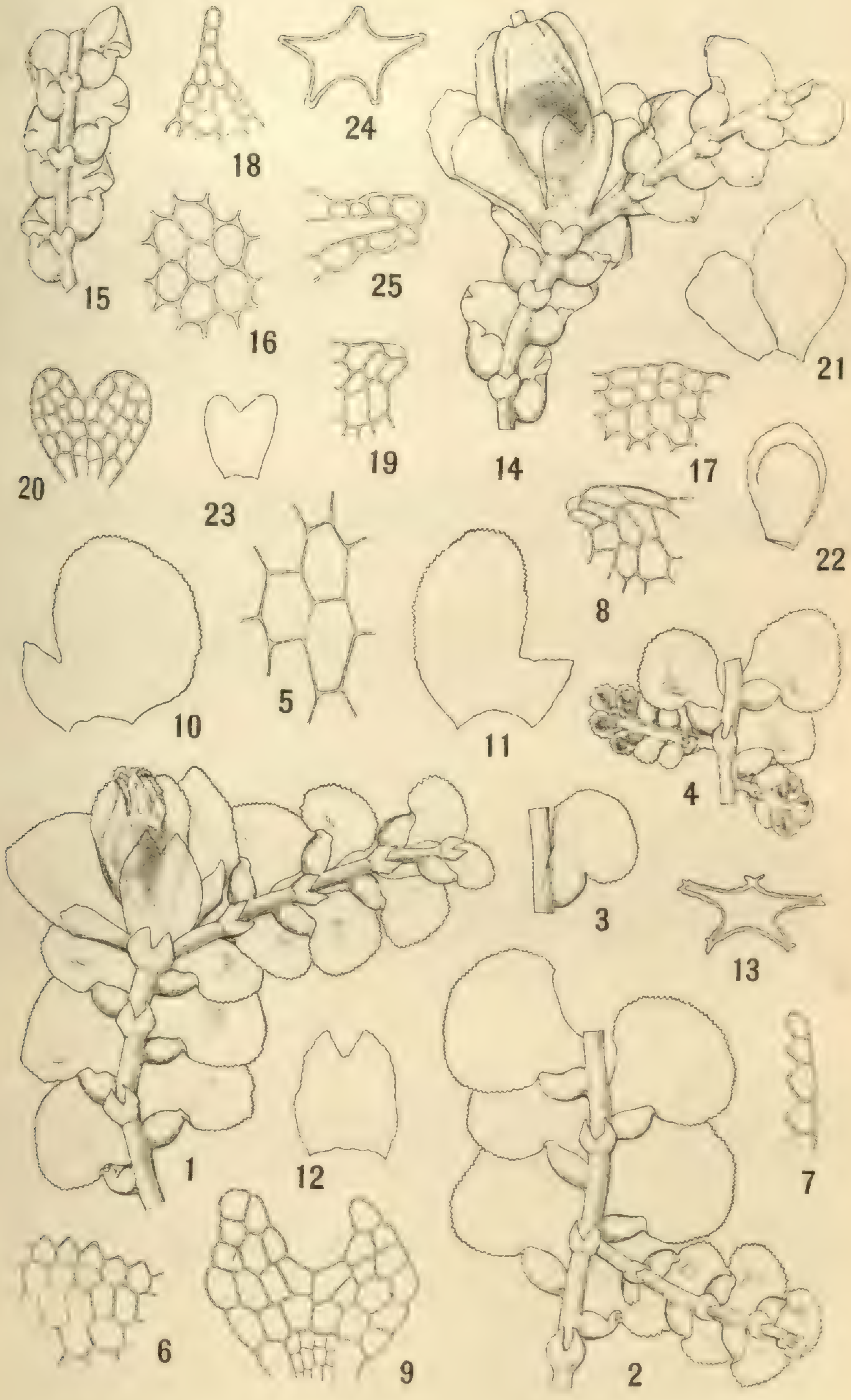
White, D. Some problems of the formation of coal. Economic Geology **3**: 292–318. [Jl] 1908.

Wilson, P. Notes on *Rutaceae.* Torreya **8**: 138, 139. 30 Je 1908.
Xanthoxylum Nashii Wilson, sp. nov. from Haïti.

Yamanouchi, S. Apogamy in *Nephrodium.* Bot. Gaz. **45**: 289–318. *pl. 9, 10 + f. 1–3.* 15 My 1908.

Zahlbruckner, A. New North American lichens. Bull. Torrey Club **35**: 297–300. 1 Jl 1908.
Six species and one variety from Arizona described as new.

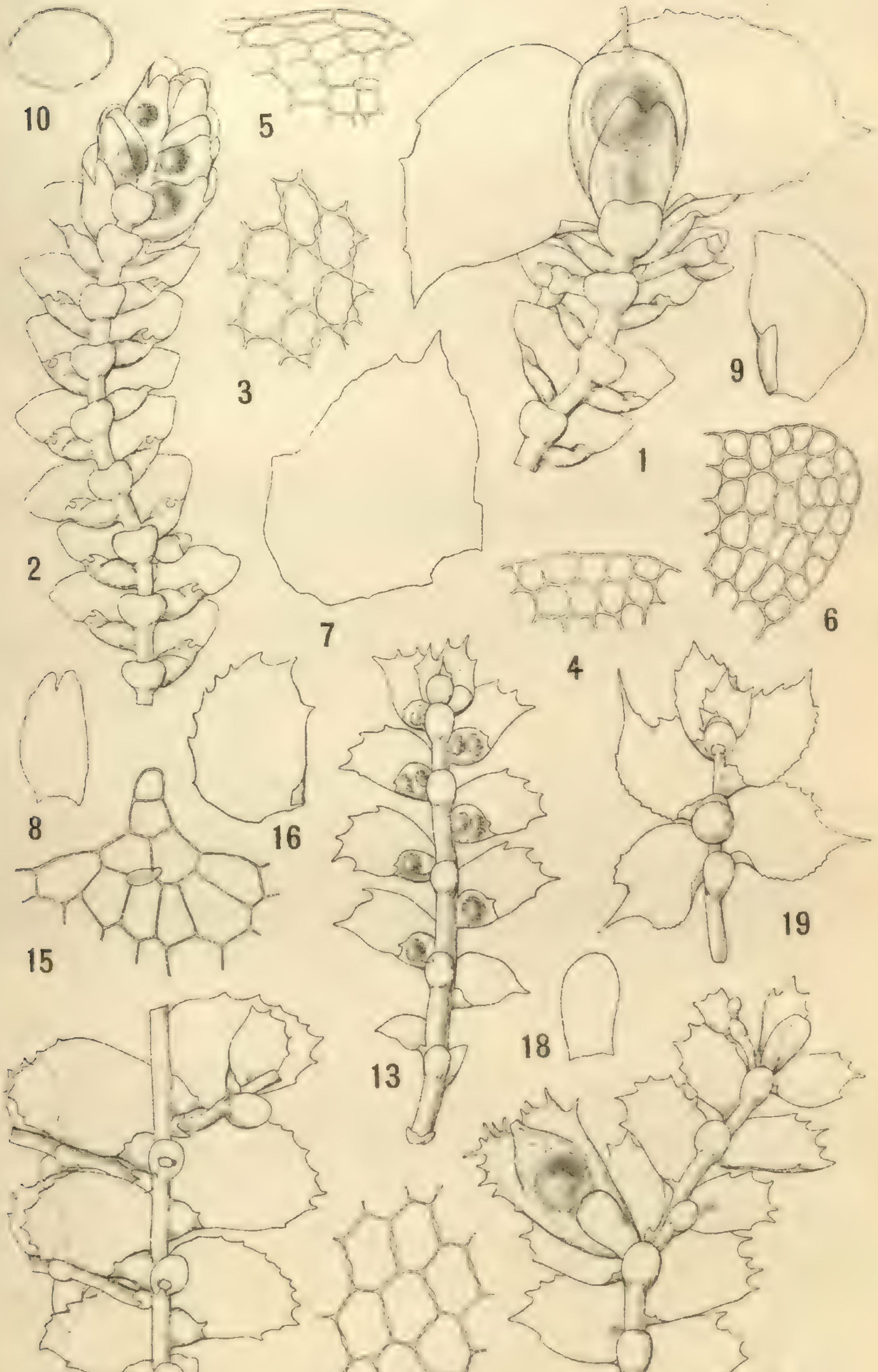
Zahlbruckner, A. Beiträge zur Flechtenflora Brasiliens. Bull. Herb. Boiss. II. **8**: 459–468. 30 Je 1908.



1-13. TRACHYLEJEUNEA DILATATA Evans

14-25. HARPALEJEUNEA REFLEXULA Evans

COCKAYNE, BOSTON

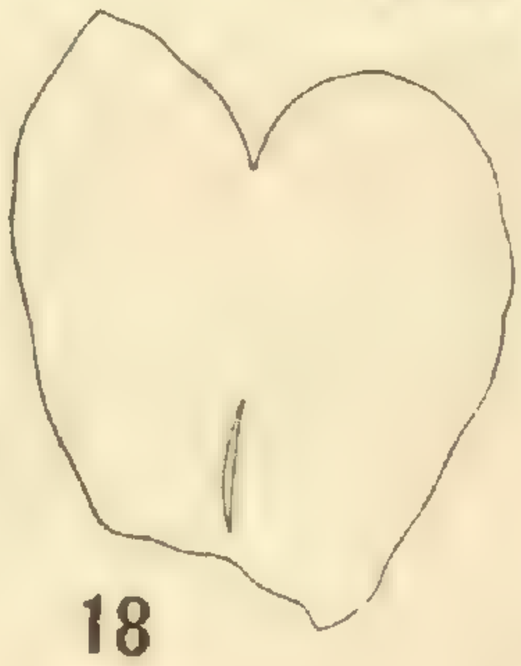


1-10. LEIOLEJEUNEA GRANDIFLORA Evans

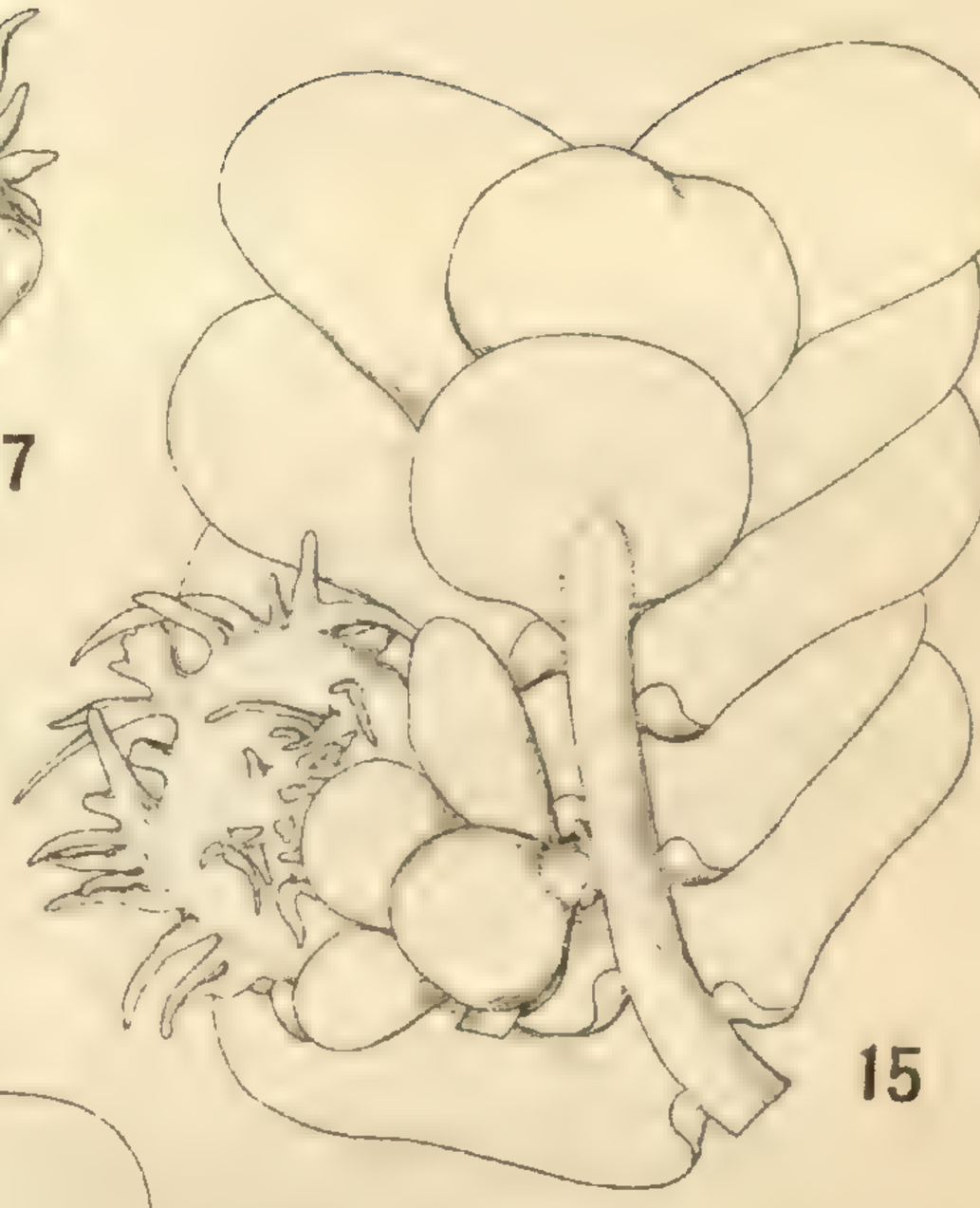
11-19. ODONTOLEJEUNEA LONGISPICA Evans

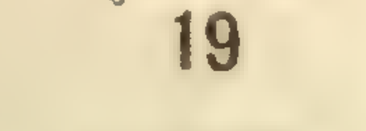
16

17


18

19

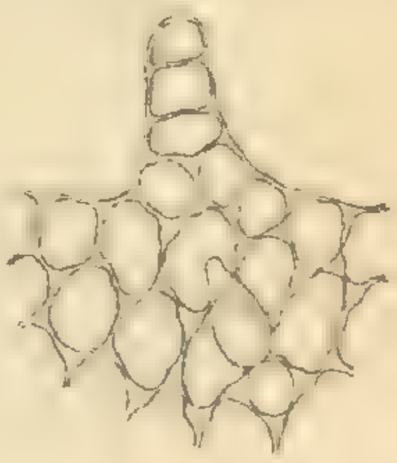

15


5

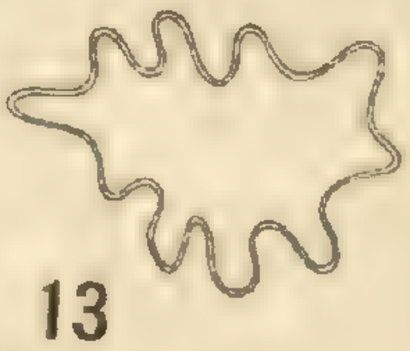
9

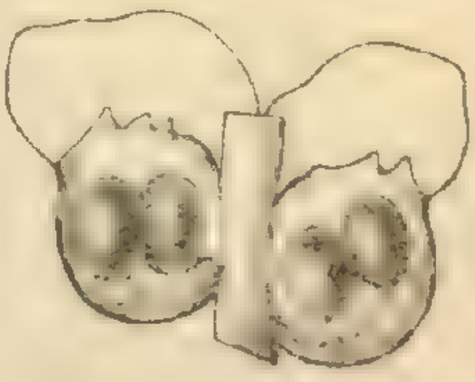
20

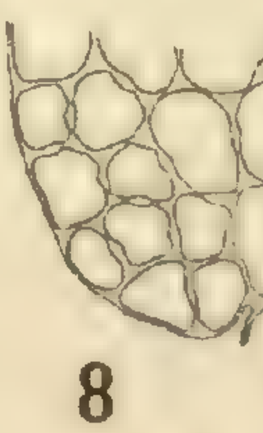
11


7

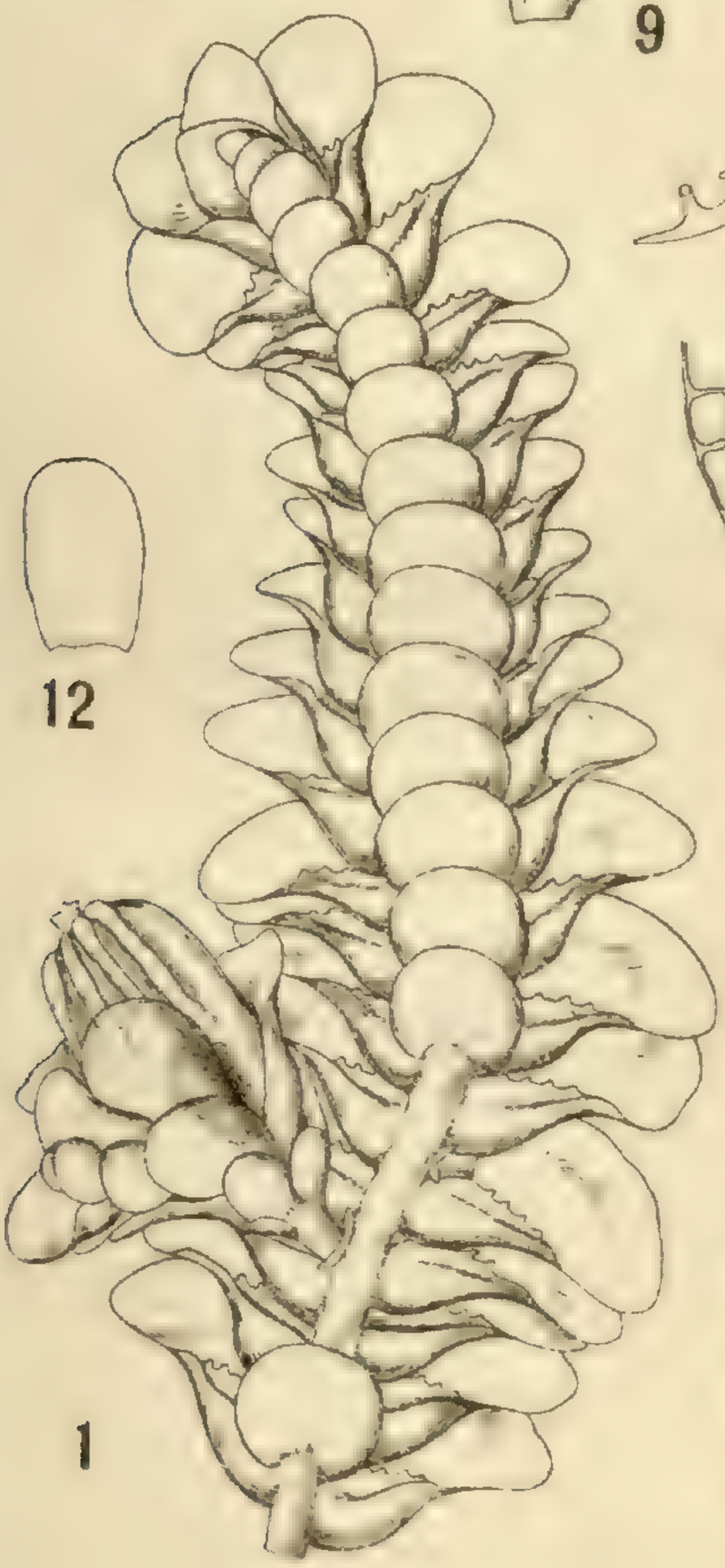
6


13

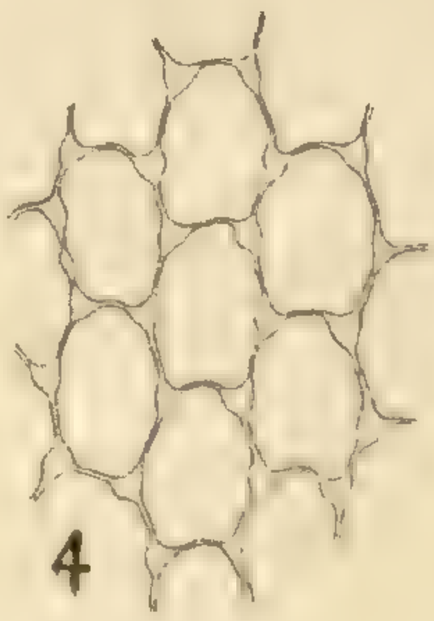

14

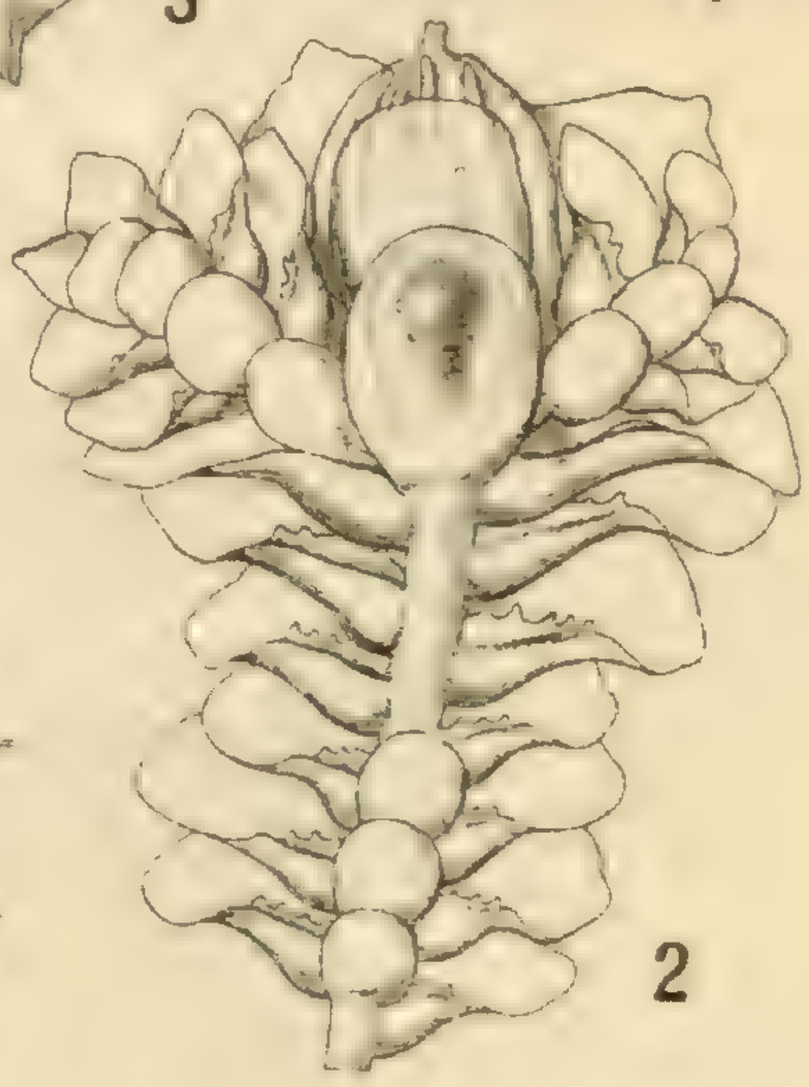

8

3


1

10


4


2

1-14. BRACHIOLEJEUNEA BAHAMENSIS Evans

15-20. SYMBIEZIDIUM LACERATUM Evans

COCKAYNE, BOSTON

THE BRYOLOGIST

WITH THE JANUARY, 1908, NUMBER BEGINS ITS

ELEVENTH YEAR AND VOLUME

It is a 16–20 page bi-monthly devoted to the study of the Mosses, Hepatics, and Lichens. It is fully illustrated with new, original, and artistic drawings and half-tones. It is indispensable to the working bryologist, professional as well as amateur. Send for sample copy. Subscription price $1.00 a year.

Address, MRS. ANNIE MORRILL SMITH, 78 Orange Street, Brooklyn, N. Y.

INDEX TO AMERICAN BOTANICAL LITERATURE

This Index, printed each month in the BULLETIN, is reissued on library catalogue cards; these are furnished to subscribers at the rate of one cent for each card.

Subscriptions to the card-issue may be addressed to the Treasurer of the Torrey Botanical Club,

WILLIAM MANSFIELD, COLLEGE OF PHARMACY, 115 W. 68th St., N. Y. City.

Beginning with January, 1903, the Index has also been reprinted on paper, on one side only, and can be furnished in that form at the rate of $3.00 a year.

North American Flora

THIS work is designed to present descriptions of all plants growing independent of cultivation, in North America, here taken to include Greenland, Central America, the Republic of Panama, and the West Indies, except Trinidad, Tobago, and Curaçao and other islands off the north coast of Venezuela, whose flora is essentially South American.

It will be published in parts at irregular intervals by the New York Botanical Garden through the aid of the income of the David Lydig Fund bequeathed by Charles P. Daly.

It is planned to issue parts as rapidly as they can be prepared, the extent of the work making it possible to commence publication at any number of points. The completed work will form a series of volumes with the following sequence:

Volume 1. Mycetozoa, Schizophyta, Diatomaceae.
Volumes 2 to 10. Fungi.
Volumes 11 to 13. Algae.
Volumes 14 and 15. Bryophyta.
Volume 16. Pteridophyta and Gymnospermae.
Volumes 17 to 19. Monocotyledones.
Volumes 20 to 30. Dicotyledones.

The preparation of the work has been referred by the Scientific Directors of the Garden to a committee consisting of Professors L. M. Underwood and N. L. Britton.

Professor George F. Atkinson of Cornell University, Professors Charles R. Barnes and John M. Coulter of the University of Chicago, Mr. Frederick V. Coville of the United States Department of Agriculture, Professor Edward L. Greene of the United States National Museum, Professor Byron D. Halsted of Rutgers College and Professor William Trelease of the Missouri Botanical Garden have consented to act as an advisory committee.

The subscription price is fixed at $1.50 for each part; it is expected that four or five parts will be required for each volume. A limited number of separate parts will be sold at $2.00 each. Address,

THE NEW YORK BOTANICAL GARDEN

BRONX PARK, NEW YORK CITY

Vol. 7. Part 1, Ustilaginales, including Ustilaginaceae and Tilletiaceae, by G. P. Clinton, was issued Oct. 4, 1906. Vol. 7, Part 2, Coleosporiaceae, Uredinaceae and Aecidiaceae (pars), of the Uredinales, by J. C. Arthur was issued March 6, 1907. Vol. 22, Part 1, including Podostemonaceae by George V. Nash, Crassulaceae by N. L. Britton and J. N. Rose, and Penthoraceae and Parnassiaceae by P. A. Rydberg, was issued May 22, 1905. Vol. 22, Part 2, including Saxifragaceae and Hydrangeaceae by J. K. Small and P. A. Rydberg, Cunoniaceae, Iteaceae, and Hamamelidaceae by N. L. Britton, Pterostemonaceae by J. K. Small, Altingiaceae by Percy Wilson and Phyllonomaceae by H. H. Rusby, was issued Dec. 18, 1905. Vol. 25, Part 1, including Geraniaceae, by L. T. Hanks and J. K. Small, Oxalidaceae and Linaceae by J. K. Small, and Erythroxylaceae by N. L. Britton, was issued Aug. 24, 1907. Vol. 9, Part 1, Polyporaceae (pars), by W. A. Murrill, was issued Dec. 19, 1907.

PUBLICATIONS BY OFFICERS AND STUDENTS OF THE DEPARTMENT OF BOTANY, COLUMBIA UNIVERSITY

1. MEMOIRS OF THE DEPARTMENT:

Vol. 1. A Monograph of the North American Species of the Genus *Polygonum* (1895). By John Kunkel Small, Fellow in Botany, 1893–1895; Curator of the Herbarium, 1895–1898.

Quarto, 178 pages, 84 plates. Price $6.00.

Vol. 2. A Monograph of the North American Potentilleae (1898). By Per Axel Rydberg, Fellow in Botany, 1896–7.

Quarto, 224 pages, 112 plates. Price $6.00.

2. CONTRIBUTIONS FROM THE DEPARTMENT:

Vol. 1. Nos. 1–25. 1886–1892. Price $5.00.
Vol. 2. Nos. 26–50. 1892–1894. Price $5.00.
Vol. 3. Nos. 51–75. 1894–1895. Price $5.00.
Vol. 4. Nos. 76–100. 1895–1896. Price $5.00.
Vol. 5. Nos. 101–125. 1896–1897. Price $5.00.
Vol. 6. Nos. 126–150. 1897–1898. Price $5.00.
Vol. 7. Nos. 151–175. 1898–1901. Price $5.00.
Vol. 8. Nos. 176–200. 1901–1902. Price $5.00.
Vol. 9. Nos. 201–. 1903–(current).

List of separate numbers available on application.

3. A Text-book of General Lichenology (1896). By Albert Schneider, Fellow in Botany, 1895–1896.

Octavo, 230 pages, 76 plates. Price $4.25 (cloth); $3.80 (paper). Published by Willard N. Clute & Co. Binghamton, N. Y.

The Department invites propositions relative to exchanges of herbarium material for any of the above named publications. Address Dr. Carlton C. Curtis, Columbia University, N. Y. City.

4. An Illustrated Flora of the Northern United States, Canada, and the British Possessions from Newfoundland to the Parallel of the Southern Boundary of Virginia, and from the Atlantic Ocean westward to the 102d Meridian (1896–1898). By Nathaniel Lord Britton, Professor of Botany, 1891–1896; Emeritus Professor 1896–, and Hon. Addison Brown.

Three volumes, royal octavo. Vol. 1, 612 pages; Vol. 2, 642 pages; Vol. 3, 588 pages; 4162 figures in the text, illustrating every species described.

Published by Charles Scribner's Sons, New York. Price, in cloth, $9.00 for the three volumes; with the indexes and keys bound separately, $10.00.

5. Our Native Ferns and their Allies. (Sixth Edition) 1900. By Lucien Marcus Underwood, Professor of Botany, 1896–1907.

Duodecimo, 158 pages, 35 figures. Published by Henry Holt & Co., New York. Price, $1.00.

6. Moulds, Mildews, and Mushrooms. By Lucien Marcus Underwood, Professor of Botany, 1896–1907.

Duodecimo, 236 pages, 10 plates. Published by Henry Holt & Co. Price $1.50.

7. Nature and Development of Plants (1907). By Carlton Clarence Curtis, Assistant in Botany, 1892–1895; Tutor in Botany, 1895–1906; Instructor in Botany, 1906–.

Octavo, 471 pages; 342 illustrations. Published by Henry Holt & Co., New York. Price $2.50.

ESTABLISHED 1851

EIMER & AMEND

205–211 Third Ave.,
Corner 18th Street

NEW YORK

MANUFACTURERS AND IMPORTERS OF

Chemicals and Chemical Apparatus

Our Specialties

MICROSCOPES
and
ACCESSORIES

MICROTOMES

BALANCES
and
WEIGHTS

Sole Agents for

C. A. F.
KAHLBAUM'S
C. P. Chemicals
and Reagents

CARL
SCHLEICHER
& SCHÜLL'S
C. P. Filters

SCHOTT &
GENOSSEN'S
Famous Laboratory Glassware

And for many other renowned European houses in our line.

COMPLETE LINE OF

Bacteriological Apparatus

WE HANDLE

Everything Needed for a Laboratory

Inspection of premises cordially invited.

MEMOIRS OF THE TORREY BOTANICAL CLUB

A series of technical papers on botanical subjects, published at irregular intervals. Price $3.00 a volume. Not offered in exchange.

Vol. 1, No. 1; not furnished separately:

Bailey, Liberty Hyde. Studies of the types of various species of the genus *Carex*. Pages 1–85. 25 My 1889.

Vol. 1, No. 2; not furnished separately:

Martindale, Isaac Comly. Marine algae of the New Jersey coast and adjacent waters of Staten Island. Pages 87–111. 24 Au 1889.

Vol. 1, No. 3; price, 75 cents:

Spruce, Richard. *Hepaticae* Bolivianae, in Andibus Boliviae orientalis, annis 1885–6, a cl. H. H. Rusby lectae. Pages 113–140. 20 Ja 1890.

Vol. 1, No. 4; price, 75 cents:

Sturtevant, Edward Lewis. On seedless fruits. Pages 141–187. 30 My 1890.

Vol. 2, No. 1; not furnished separately:

Halsted, Byron David. Reserve food-materials in buds and surrounding parts. Pages 1–26, *plates 1, 2*. 10 S 1890.

Vol. 2, No. 2; price, 75 cents:

Vail, Anna Murray, & Hollick, Charles Arthur. Contributions to the botany of Virginia. Pages 27–56, *plates 3, 4*. 23 D 1890.

Vol. 2, No. 3; not furnished separately:

Holm, Herman Theodor. Contributions to the knowledge of the germination of some North American plants. Pages 57–108, *plates 5–19*. 15 Ap 1891.

Vol. 2, No. 4; price, 75 cents:

Wheelock, William Efner. The genus *Polygala* in North America. Pages 109–152. 30 D 1891.

Vol. 3, No 1; not furnished separately:

Small, John Kunkel, & Heller, Amos Arthur. Flora of western North Carolina and contiguous territory. Pages 1–39. 20 F 1892.

Vol 3, No. 2; price, $2.00:

Morong, Thomas. The *Naiadaceae* of North America [with illustrations of all the species]. Pages 1–65, *plates 20–74*. 15 Mr 1893.

Vol. 3, No. 3; not furnished separately:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. [Part 1.] Pages 1–67. 28 Ap 1893.

Vol. 4, No. 1; not furnished separately:

Underwood, Lucien Marcus. Index *Hepaticarum*. Part I, Bibliography. Pages 1–91. 10 Je 1893.

Vol. 4, No. 2; not furnished separately:

Small, John Kunkel, & Vail, Anna Murray. Report on the botanical exploration of southwestern Virginia during the season of 1892. Pages 93–201, *plates 75–82*. 18 N 1893–17 Ap 1894.

Vol. 4, No. 3; price, 50 cents:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 2. Pages 203–274. 10 Mr–17 Ap 1895.

Vol. 4, No. 4; price, 50 cents:

Pettit, Anna Stockton. *Arachis hypogaea* L. Pages 275–296, *plates 83–85* 5 Je 1895.

Vol. 4, No. 5; price, 75 cents:

Rydberg, Per Axel. The North American species of *Physalis* and related genera. Pages 297–374. 15 S 1896.

Vol. 5; price, $3.00:

List of *Pteridophyta* and *Spermatophyta* growing without cultivation in northeastern North America. Pages 1–377. 4 D 1893–31 D 1894.

Vol. 6, No. 1; price, $1.25:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 3. Pages 1–130. 17 N 1896.

Vol. 6, No. 2; not furnished separately:

Grout, Abel Joel. A revision of the North American *Isotheciaceae* and *Brachytheci*. Pages 131–210. 30 Jl 1897.

Vol. 6, No. 3; price, 50 cents:

Hazen, Tracy Elliot. The life history of *Sphaerella lacustris* (*Haematococcus pluvialis*). Pages 211–246, *plates 86, 87* (*colored*). 8 Je 1899.

Vol. 6, No. 4; price, 50 cents:

Underwood, Lucien Marcus. A review of the genera of ferns proposed prior to 1832. Pages 247–283. 1 D 1899.

Vol. 6, No. 5; price, 25 cents:

Fink, Bruce. Notes on lichen distribution in the upper Mississippi Valley. Pages 285–307. 1 D 1899.

Vol. 7; price, $3.00:

Howe, Marshall Avery. The *Hepaticae* and *Anthocerotes* of California. Pages 1–208, *plates 88–122*. 5 Au 1899.

Vol. 8, No. 1; not furnished separately:

Lloyd, Francis Ernest. The comparative embryology of the *Rubiaceae*. Part I. Pages 1–26, *plates 1–4*. 26 Au 1899. Part II. Pages 27–112, *plates 5–8*. 15 F 1902.

Vol. 8, No. 2; price, $1.00:

Evans, Alexander William. The *Lejeuneae* of the United States and Canada. Pages 113–183, *plates 16–22*. 15 F 1902.

Vol. 8, No. 3; price, 75 cents:

Britton, Elizabeth Gertrude, & Taylor, Alexandrina. The life history of *Vittaria lineata*. Pages 185–211, *plates 23–31*. 30 Au 1902.

Vol. 9; price, $3.00:

Salmon, Ernest Stanley. A monograph of the *Erysiphaceae*. Pages 1–292, *plates 1–9*. 4 O 1900.

Vol. 10; price, $3.00:

Burgess, Edward Sandford. History of Pre-Clusian botany in its relation to Asia. Pages i–xii, 1–447. 22 N 1902.

Vol. 11, No. 1; price, $1.75:

Griffiths, David. The North American *Sondariaceae*. Pages 1–134, *plates 1–11*. 30 My 1901.

Vol. 11, No. 2; price, $1.75:

Hazen, Tracy Elliot. The *Ulothricaceae* and *Chaetophoraceae* of the United States. Pages 135–250, *plates 20–42*. 20 O 1902.

Vol. 12, No. 1; price, $1.50:

Northrop, Alice Rich. Flora of New Providence and Andros (Bahama Islands). Pages 1–98, *plates 1–19 + map*. 10 D 1902.

Vol. 12, No. 2; price, $1.00:

Banker, Howard James. A contribution to a revision of the North American *Hydnaceae*. Pages 99–194. 13 Je 1906.

Vol. 12, No. 3; price, 75 cents:

Kupfer, Elsie. Studies in plant regeneration. Pages 195–241. 10 Je 1906.

Vol. 13; price, $3.00:

Burgess, Edward Sandford. Species and variations of Biotian Asters, with discussion of variability in *Aster*. Pages i–xv, 1–419, *plates 1–13*. 15 Mr 1906.

Vol. 14, No. 1; price, $1.25:

Burlingham, Gertrude Simmons. A study of the *Lactariae* of the United States. Pages 1–109, *figures 1–15*. 26 My 1908.

Address: **TORREY BOTANICAL CLUB.**
Columbia University, New York City.

VOL. 35 SEPTEMBER, 1908 NO. 9

BULLETIN

OF THE

TORREY BOTANICAL CLUB

Editor

MARSHALL AVERY HOWE

Associate Editors

JOHN HENDLEY BARNHART
JEAN BROADHURST
PHILIP DOWELL
ALEXANDER WILLIAM EVANS
TRACY ELLIOT HAZEN
WILLIAM ALPHONSO MURRILL
CHARLES LOUIS POLLARD
HERBERT MAULE RICHARDS

CONTENTS

The Fruit Spot of apples. (Plates 29-35) . . . . . CHARLES BROOKS 423
Notes on Philotria Raf. . . . . PEX AXEL RYDBERG 457
INDEX TO AMERICAN BOTANICAL LITERATURE. 467

PUBLISHED FOR THE CLUB

THE NEW ERA PRINTING COMPANY
LANCASTER, PA.

THE TORREY BOTANICAL CLUB

President,

HENRY H. RUSBY, M.D.

Vice-Presidents,

EDWARD S. BURGESS, PH.D. JOHN HENDLEY BARNHART, A.M., M.D.

Recording Secretary,

C. STUART GAGER, PH.D.

Botanical Garden, Bronx Park, New York City.

Treasurer,

WILLIAM MANSFIELD, PHAR.D.

College of Pharmacy,
115 West 68th St., New York City.

MEETINGS

Meetings twice each month from October to May inclusive: the second Tuesday, at 8:00 P.M., at the American Museum of Natural History; the last Wednesday, at 3:30 P.M., in the Museum Building of the New York Botanical Garden.

PUBLICATIONS

All subscriptions and other business communications relating to the publications of the Club should be addressed to the Treasurer, William Mansfield, College of Pharmacy, 115 West 68th St., New York City.

Bulletin. Monthly, established 1870. Price, $3.00 a year; single numbers 30 cents. Of former volumes, only 24–34 can be supplied separately; certain numbers of other volumes are available, but the entire stock of some numbers has been reserved for the completion of sets. Manuscripts intended for publication in the BULLETIN should be addressed to Marshall A. Howe, Editor, New York Botanical Garden, Bronx Park, New York City.

Torreya. Monthly, established 1901. Price, $1.00 a year. Manuscripts intended for publication in TORREYA should be addressed to Jean Broadhurst, Editor. Teachers College, Columbia University, New York City.

Memoirs. Occasional, established 1889. (See last pages of cover.)

Preliminary Catalogue of Anthophyta and Pteridophyta within 100 miles of New York City, 1888. Price, $1.00.

Vol. 35 No 9

BULLETIN

OF THE

TORREY BOTANICAL CLUB

SEPTEMBER, 1908

The Fruit Spot of apples

CHARLES BROOKS

(WITH PLATES 29–35)

A considerable percentage of the Baldwin apples of New England are marred by the presence of certain fruit spots, described in the bulletins of the New Hampshire Experiment Station as the Brown Spot of Baldwins. The following paper is a report of the results obtained in an effort to determine the cause of this spot, its morphological and physiological characteristics, and means of prevention. A brief review of earlier work on this and closely related effects will be of value in the later presentation of the subject matter.

REVIEW OF LITERATURE

In 1879 Sorauer (1) described a disease which he called the "Stippichwerden der Aepfel." According to his description, brown or blackish brown spots developed on the surface of the fruit, extending into the flesh only .5 to 1.5 mm. These spots remained isolated and never involved the whole fruit. He found that they might remain without development for a long time and later develop rapidly in storage. He considered the spots to be due to a decomposition produced by a particular fungus and gave *Spilocaea Pomi*, previously described by Fries (2), as the probable agency.

Reichelt (3) reported a similar spot on apples but found that it was caused by a fungus belonging to the genus *Synchytrium*.

Frank (4) thought that the *Spilocaea Pomi* of Fries was a

[The BULLETIN for August, 1908 (35 : 371–422. *pl. 26–28*) was issued 26 Au 1908.]

sterile form of *Fusicladium dendriticum*, thus making the "Stippen der Aepfel" identical with scab.

Wortmann (5) made extensive studies of the "Stippen der Aepfel." He described the disease as producing numerous brown spots on the surface of the fruit. At first these were but 1 to 5 mm. in diameter and entirely separate and distinct, but later they might become larger and more numerous, practically covering the entire surface of the apple. The spots usually developed after the fruit had been gathered and while it was passing through its final ripening processes, but with especially susceptible varieties they sometimes appeared while the apples were still on the tree. The tissue beneath these spots was browned, possessed an overabundance of starch and in late stages was bitter to the taste. He did not consider the disease to be of fungous origin, not only because he was unable to find any trace of mycelium in the affected tissue but also from the fact that the spots were often covered by a smooth and unbroken epidermis and might be found at a depth of one centimeter from the surface and entirely separated from all other affected tissue. He believed that the disease was a physiological one and that conditions of transpiration were largely responsible for its occurrence. He found that varieties of apples that were susceptible to spotting had more lenticels and a thinner-walled epidermis than those less affected by the disease. On the other hand, these same susceptible varieties gave off less water in transpiration than the more resistant ones. From these observations and from the previously known fact that spotting might be prevented by a rapid drying of the fruit, he drew the conclusion that the extent of the disease was not determined by the actual amount of transpiration but by the readiness with which water was conducted from deeply seated cells to replace that lost in transpiration. The varieties that had the slowest rate of conduction were the ones that were most seriously affected. The concentration of the cell sap in the exposed tissue was the real cause of the injury and the acids and acid salts were the active agents in killing the cells. As an explanation of the fact that apples do not become spotted when dried very rapidly, he suggested that under such conditions the acid did not have time to act. He believed that the nature of the substances in the cell

sap partially accounted for the differences in the susceptibility of different varieties.

Zschokke (6) presented a detailed report in regard to the structure of the epidermis in core-fruits with special reference to the part it plays in determining their keeping quality. His description of the "Stippen" and his conclusions in regard to it are almost identical with those of Wortmann.

In Australia a disease supposed to be identical with the "Stippen" is described by Cobb (7) as Brown or Bitter Pit.

Craig (8) described a similar disease occurring in Canada as the Dry Rot of the apple. He found that sixty different varieties of apples were susceptible, but that the Baldwins were affected most seriously.

In the United States the spotting of apples has been repeatedly described and variously named. Selby (9) reported a disease of Northern Spies and other varieties which produced small brown spots just beneath the skin of the apple and which usually did not extend to any great depth into the tissue. He found no fungus present and considered it a breaking down of cells brought about by seasonal conditions.

Jones (10) described the "Brown Spot of the Baldwin Apple" as producing brown sunken spots the size of a pea or larger on the surface of the apple. The flesh underneath these spots showed a brown discoloration for an eighth of an inch or more in depth. The discolored portion was quite bitter to the taste. Specimens of the diseased fruit placed in a moist chamber soon developed small grayish pustules at or near the center of the spot, the pustule being from a sixteenth to an eighth of an inch in diameter. Specimens of the fungus were sent to J. B. Ellis for identification who reported that it was probably *Dothidea pomigena* Schw. Later, Jones (11) stated that the fungus occurring in the spots was quite different from the above species. In most cases, especially in the autumn and early winter, no fungus was detected in the browned tissue. When it was present it was quite obscure. The fungus was not identified because of inability to secure satisfactory fruiting specimens. He considered the fungus a saprophyte and of minor importance so far as the disease was concerned. In the later publication the spotting was given the following description:

"The disease usually appears superficially on the fruit as small sunken brown spots scattered over the surface of the apple, but more abundantly near the eye or apical portion. These spots may appear before maturity, but usually are seen only after the apples have lain in storage for some time, and tend thereafter to increase in number and size. The spots usually vary in diameter from two to five millimeters. The superficial spots usually lie immediately underneath the epidermis, which in the earlier stage of their development is unbroken. Upon cutting into such a spot it is found to consist of rather dry, dead and browned tissue, extending into the flesh for a distance about equal to its diameter. Similar areas of dead and brown tissue may occur scattered at various depths in the flesh nearly to the core. Examination shows the spots to be associated in their distribution with the occurrence of the vascular bundles of the fruit. The browned tissue may have a slightly bitter flavor in the older spots, but this bitterness is not constant and in no case in our observation is it very decided."

He found that while the spotting was worse on Baldwins than on any other variety it was quite common on Northern Spies and occurred on Greenings.

Stewart's (12) description of the "Baldwin Spot" is quite similar to that given by Jones. He did not detect the bitter taste that Jones had found the browned tissue to have. The smallest spots might show no brown color at all but be indicated merely by a deeper red color of the skin if situated upon the colored part of the fruit, or by a green color if situated upon the lighter portion. At the time the fruit was gathered the spongy tissue was found only underneath the surface spots, but after it had lain some three weeks in the laboratory many brown spots were found distributed irregularly through the flesh of the calyx half of the fruit, but not in the stem half. Apples placed in moist chambers showed no development of any fungus and pieces of browned tissue transferred to various culture media gave no growth. No beneficial results from spraying had been observed. In a later bulletin (13), an orchard was reported in which the disease had been almost entirely prevented by spraying. The most susceptible varieties were Baldwin, Northern Spy, and Rhode Island Greening.

Clinton (14) described the "Baldwin Spot" as showing first

in the fall as small sunken rotten spots on the surface of the fruit and later as isolated brown spots within the flesh, the tissue in these often collapsing.

In a later report (15) he described another disease of the apple which he called the "Fruit Speck." This disease showed superficially as small spots or specks scattered over the skin. These areas of brownish dead tissue usually varied from the size of a pinhead to a quarter of an inch in diameter and extended but slightly into the flesh. He could frequently see small ruptures at the center of the specks. Diseased tissue when placed in sterile culture media developed a fungous growth. The fungus in the various cultures was apparently the same. Talman Sweets were most seriously affected, Northern Spies suffered less, while Baldwins were injured but little.

Longyear (11) reported a disease common on Baldwins and other varieties in Michigan which he called the "Fruit Spot" of apples. He described it as appearing in the form of small, circular, slightly sunken spots of a brown color. The brown discoloration usually extended but a little way into the flesh of the fruit and the affected part possessed a bitter taste. The spots gave rise to spore-producing pustules. *Phyllachora pomigena* (Schw.) was credited as the cause of the trouble. Spraying as for scab was found greatly to reduce the disease.

Lamson (17) has published a number of reports on the "Brown Spot of Baldwins" as it occurs in New Hampshire. He gave the following description of the disease: "It is characterized by the appearance on the surface of the apple of numerous small brown spots, varying in diameter from a sixteenth to an eighth of an inch. The spots are slightly sunken or depressed so that the surface has a pitted appearance. They suggest the beginning of rot but do not increase in size ordinarily, though occasionally they do. The disease appears late in the season. The chief injury is to the appearance of the fruit. This is often so much damaged that otherwise perfect apples become seconds." He found that fungicides practically controlled the disease.

For the past two years the writer has been making a study of the spotting of New Hampshire apples. The results obtained are given under the various headings that follow. A knowledge of the host is necessary to an understanding of a disease.

THE STRUCTURE AND DEVELOPMENT OF THE APPLE

Epidermal structure. — The epidermis of the apple consists of a single layer of cells, the outer walls of which are strongly thickened. These outer walls consist largely of cutin, which as the apple matures is impregnated and covered with a resinous and waxy substance. The apple is thus furnished with a covering that at most points is practically impervious to water and fungi. Many unicellular hairs are found on the surface of the young fruit. The somewhat conical bases of these are inserted between the other epidermal cells. These hairs disappear when the apple is a few weeks old, but before this time the cuticle of the apple has considerable thickness. Zschokke (6) found that in dropping from the apple the hairs might break even with the outer edge of the cuticle, leaving their conical bases behind, but that more frequently they loosened themselves from the surrounding epidermal cells, leaving a deep scar, which, in the later development of the fruit, might become a definite break in the epidermis. The writer's observations agree with those of Zschokke. As late as the first of August these hair pits were quite common in the epidermis.

In the young fruit the stomata furnish such openings in the epidermis as are necessary for the passage of gases and liquids. They are very numerous early in the year and while the majority of them disappear later they are still quite common on the mature fruit. From three to four weeks after the fall of the blossoms numerous cork-like flecks begin to appear on the apple surface. The majority of these are lenticels (PLATE 32, FIGURE 4). When the epidermis of the young apple is broken, either through a natural or foreign agency, the opening is rapidly covered with cork cells. According to Zschokke (6) the lenticels develop as a result of breaks in the epidermis caused by the rapid enlargement of the apple, the stomata being the points that yield most readily to the strain. In a typical lenticel the cells are arranged in definite layers. In the apple the structure of these corky specks varies all the way from that of a typical lenticel to a few thick-walled cork cells promiscuously arranged beneath a minute break in the cuticle. Their early structure leads the writer to the opinion that while the majority of them develop at stomata others probably originate from the pockets left by the falling hairs.

The lenticels are far more numerous on the blossom half than on the stem half of the apple. This statement is based on actual count as well as on general observations. A square centimeter was marked off on the stem half of an apple and another on the blossom half and the lenticels counted on these areas. By averaging the results secured from ten Baldwins the ratio of seven to four was obtained as that existing between the number of lenticels on the blossom and stem halves of the apple. On Northern Spies the ratio was approximately five to three.

Hypodermal parenchyma. — Immediately beneath the epidermis are layers of cells that are distinctly different from those more deeply situated. These cells are smaller and more compactly arranged. They are oblong in shape with their greatest diameter parallel to the epidermis. They are rich in chlorophyll and take an active part in the nutrition of the apple. They contain the red coloring-matter of the fruit, which, according to Pick (18), develops from tannin under the influence of sunlight. There is a gradual transition from these cells to the large isodiametric ones that make up the mass of the apple tissue.

Vascular system. — The close relation of the conducting system to spot diseases makes a study of the vascular bundles of interest in this connection. The general distribution of these could be studied best in frozen apples. With these the soft flesh could be nearly all removed by holding the half of an apple under the current from a laboratory faucet. The remaining portion of the apple could be very satisfactorily studied by floating it in water. If an apple is cut into halves perpendicular to the core, ten green spots may be seen arranged in the form of a circle about midway between the core and the epidermis (PLATE 31, FIGURE 1). These are the large vascular strands of the apple. Smaller branches are given off from either side of them. FIGURE 7, PLATE 35 is a sketch of one of these ten vascular strands with the branches that arise from one side of it, *i. e.*, it shows about one twentieth of the vascular system of an apple. The main branches give off comparatively few smaller ones before reaching the margin of the surface zone of cells previously described. Here they branch profusely and anastomose in a seemingly indiscriminate manner. The veinlets from one large vein unite with those from another so that

the whole surface system is closely interwoven and connected. In the small veinlets the vascular elements become fewer and fewer, finally giving place to long narrow cells that seem to be transitional between the vascular tissue and that of the apple pulp.

Chemical composition. — The chemical composition of the apple varies greatly with the time of the year.

Pfeiffer (19) reported that crude fiber, ash, protein, sugar, acid, water, pectin, and dextrin all increased in the apple during growth.

Bigelow, Gore, and Howard (20) found that the sugar content of winter apples increased from the time of the June drop till November 5, when the apples began to break down and become mealy. During this time the acid, as estimated on a total solids basis, was constantly decreasing. These changes in the sugar and acid content took place very rapidly in the latter half of June and early part of July. The starch content reached its maximum before the last of July and rapidly decreased after that time.

Morse (21) found that the most important change in the apple in the "after-ripening" process was the change of starch to sugar. Cold storage retarded this and other chemical changes but could not prevent them.

Otto (22) reported that when ripe apples were allowed to sweat in piles the starch was entirely converted into sugar in two or three weeks, the fruit thus becoming more valuable for cider-making.

Zschokke (6) reported that the tannin content decreased in the ripening process. He found that the tannin was located largely in the surface cells of the apple. He believed that apples owed their resistance to decay fungi much more to the chemical composition of the cell sap, especially to the tannic and malic acid content, than to any mechanical protection.

THE FRUIT PIT OF APPLES

The writer finds that there are two distinct fruit spots that occur on New Hampshire apples. Some stages of either of these might be included under any of the previously mentioned descriptions. In the following pages one of these will be called the Fruit Pit and the other the Fruit Spot of the apple.

Characteristics.—In early stages of the Fruit Pit one finds numerous sunken areas from two to six millimeters in diameter on the

surface of the apple. These depressions are somewhat hemispherical in shape and have the appearance of bruises. At this stage the spots are not brown and often show no difference in color from the surrounding surface of the apple. They may be a deeper red than the adjacent tissue when occurring on the colored portion of the apple and a darker green when on the lighter parts. Later they begin to take on a brown tint, but at first this seems to show through from rather deeply seated tissue and not to arise from any discoloration of the epidermal or immediately underlying cells. Sections of such spots show that this is the case, and that the browning and the shrinking of the cells occur in the pulp of the fruit and in the tissue that is transitional between it and the hypodermal parenchyma. Later the surface cells also become dark brown. The epidermis may be smooth and apparently unbroken in both early and late stages. As the disease advances spots situated near each other often become confluent, developing into one large spot. In all such cases examined it was found that the original spots were closely connected with one vascular branch. The writer has been unable to detect a bitter taste in the browned tissue of the fruit pits.

Internal browning of tissue. — The surface spotting is often accompanied by browning of the tissue immediately surrounding the vascular bundles. Upon cutting such an apple one sees numerous apparently isolated brown spots. Further study shows that these are not isolated but are in reality continuous strands of brown tissue surrounding the vascular bundles. The portion of the vascular system that is most commonly affected is that lying within fifteen millimeters of the surface of the apple (PLATE 31, FIGURE 3). The surface spots often occur without the internal browning and also the internal browning may occur unaccompanied by any evident surface derangement.

Cause and occurrence. — Microscopical examinations of fruit pits have given no indication of the presence of fungi or bacteria. Brown tissue from the surface pits and from the more deeply seated vascular regions has been transferred to various culture media but always without securing bacterial or fungous growth. Both the fruit pit and the internal browning are evidently abnormal physiological conditions. Their nature and location would indi-

cate that they might be the result of some abnormal loss of water from the apple tissue.

The writer's observations give him no reason to conclude that the Fruit Pit is of common occurrence in New England. Within the last three years he has seen it on but one lot of New Hampshire apples. In this case the disease developed in cellar storage on some very large Baldwins that had been picked early in the fall. Frequent visits to the Boston markets for a study of spotted apples convince him that it is of rare occurrence on the fruit shipped to that city. Within the past year he has also made an unsuccessful search for specimens of Fruit Pit in the markets of Buffalo, Chicago, Toronto, and Montreal. He has recently had the privilege of making a study of the disease on apples from Maine, Michigan, and New York, from Ottawa, Canada, and from Cape Town, Africa. The specimens from all these sources had the characteristics previously given.

THE FRUIT SPOT OF APPLES

Occurrence and morphology. — This disease is very common in New Hampshire and in the Boston markets one can often find barrels of apples shipped from various sections of New England in which fifty to ninety per cent. of the fruit is spotted. It occurs on almost every variety of apple but is worst on the Baldwins, and the following statements apply especially to the conditions as seen on that variety. The disease appears about the middle of August. At this time one may notice spots of a deeper red on the colored surface of the apple and of a darker green on the lighter portion. They are but slightly sunken if at all and there is no suggestion of a bruise (PLATE 29, FIGURE 1). They usually occur at a lenticel but are sometimes covered with a smooth and apparently unbroken epidermis. The number on the blossom half of the apple is usually from two to ten times as great as that on the stem half. A part of this contrast might be accounted for by the difference in the number of lenticels on the two halves of the apple (see page 429), but must be partly due to some other cause. As the season advances the spots become more prominent (PLATE 29, FIGURE 2). On the red fruit surfaces they become more sunken and their color gradually changes from red to brown or black. At this

time they bear a close resemblance to the earliest stages of Black Rot. Sections of the spots show that the hypodermal parenchyma is affected from the first. Only in late stages does the browning and shrinking extend to the large isodiametric cells of the apple tissue. On the green surfaces the spots may become sunken before harvest time, but the depressions are due to a lack of growth and not to any shrinking of the flesh. A minute black speck usually develops at the lenticel and smaller specks may often be seen at a radial distance of one to three millimeters from the first. A microscopic study of the underlying tissue shows that the cell walls of the hypodermal parenchyma and transitional tissue are abnormally thickened and that this thickening is especially prominent in certain groups of brown cells that underlie the surface specks (PLATE 30, FIGURES 1, 2). In the center of these brown cell-masses one often finds small pockets produced by the collapse of one or two cells. In cellar storage the red spots become badly browned and sunken. The green spots may take a similar course but in many cases there is no marked change in their surface appearance. Under such circumstances, however, one often finds that the disease is spreading deeper into the tissue and that a pocket is being developed as a result of the shrinking of the cells (PLATE 30, FIGURE 3).

The development of the spots depends greatly upon seasonal and storage conditions. When the weather is damp and foggy during the last weeks before harvesting, the spots on the red fruit surfaces develop rapidly and become black and sunken before the fruit is removed from the tree. After gathering, the spots develop most rapidly on apples placed in boxes and barrels in cellar storage. On apples placed immediately in cold storage the spots make but little or no development. When apples are stored in a warm, dry place and wither rapidly, brown spots are not developed. On the withered fruit the green spots often stand above the surrounding portions, forming smooth green elevations that are in marked contrast with the yellow withered skin of the apple. Like the Fruit Pit the Fruit Spot is often accompanied by a browning of the vascular tissue. In late stages of the Fruit Spot one sometimes finds minute elevations at the lenticels in the center of the brown sunken areas. These seem to furnish the only distinguishing characteristic between the Fruit Spot and Fruit Pit at this stage.

It would be difficult to decide from the earlier descriptions given in the bulletins of the New Hampshire station (17) whether the Fruit Spot or the Fruit Pit was under special observation. The descriptions are better if taken as applying to the two diseases than if considered as applying to either to the exclusion of the other. The spraying experiments (17) were undoubtedly made upon the Fruit Spot. So far as the writer has been able to learn, a distinction between these two diseases has never been made.

An associated fungus. — As a result of spraying experiments made in the summer of 1906 the writer obtained data that agreed with those of Lamson (17) as to the value of fungicides in preventing the spotting of apples. Such results could be explained only by assuming that the disease was of fungous origin or that Bordeaux had some remarkable and undescribed effect upon the skin of the apple. The former supposition seemed far the more probable. As an initial test of the hypothesis, blocks of browned tissue were removed from beneath the epidermis of the apple and placed in sterile culture media. Agar and gelatin cultures in which the nutrient substance was furnished by a decoction of beets, beans, beef, or apples were tried with little but negative results. The growths upon the different bouillons were too varied to give any indication of a common fungus. It was noticed, however, that after sections of spots had been left in water for a few days they were overgrown by a fungus and matted together. The fungus was always the same and always started from the center of the spots. As a result of these observations liquid media were given a more thorough trial. Browned tissue was transferred to sterile distilled water and in four or five days the blocks were fastened to the bottom of the test-tube or Petri dish. In fourteen days a fungous mass six to ten millimeters in diameter had developed. Similar results were obtained with various bouillons, and while the growth was quite unlike in the different media, transfers from one to another proved that the fungus was the same in all. It was also found that the fungus had not been obtained in the agar and gelatin cultures because their surfaces dried too quickly to give it time to develop. Placing the cultures in moist chambers remedied this trouble, but the development was slower than that in liquid cultures.

This constant occurrence of the same fungus in the diseased tissue suggested that it might be the cause of the trouble. In view of the fact that fungi had been reported as being present in late stages of Fruit Spot, but had not been found to be present in earlier stages and again that no fungus had been reported as a factor in producing the trouble, one did not seem justified in drawing any conclusions until further studies had been made. It was important to determine whether the fungus is present in the earliest stages of the spots and whether it can be made to produce similar effects by artificial inoculation. Also, it was of interest to know from what sources the fungus can be obtained.

SOURCES FROM WHICH THE FUNGUS HAS BEEN OBTAINED

For an investigation of this phase of the subject some fifty lots of apples were tested and as many as six hundred separate cultures made. More than ninety per cent. of the cultures made from the green spots and about seventy per cent. of those made from the red spots gave a pure growth of the same fungus. More than fifty per cent. of the contaminations obtained from the red spots were due to *Sphaeropsis malorum* Berk. It was found that the fungus could be isolated from spots covered with a smooth and glaucous epidermis as well as from those having a lenticel in the center. The compound microscope revealed the fact, however, that the spots that seemed to be covered by an unbroken epidermis in reality had a stoma at the center.

In the summer of 1907 spots were tested for the fungus from their earliest appearance. The same fungus was obtained from these earliest stages as was found in the later ones. Cultures of the fungus were obtained from Talman Sweets and Gravensteins on August 21, and from Baldwins on August 28. In these as in all other cases the tissue for inoculation was removed from beneath the epidermis by means of a sterilized knife. At this time the spots had little or no brown corky growth beneath them.

Within the past two years the fungus has been isolated from apples obtained from Delaware, New York, Michigan, Maine, and Massachusetts, from Toronto and Montreal in Canada, and from the following points in New Hampshire: Webster, Durham, Lee, Wilton, Madbury, Walpole, Packer's Falls, Barrington, Deerfield,

Dover, and Nashua. It has been obtained from the following varieties: Baldwin, Greening, Northern Spy, Talman Sweet, Red Canada, Canada Baldwin, Red Astrachan, Fall Pippin, Bellflower, Gravenstein, Grimes Golden, Russet, Porter, Snow, Wealthy, Ben Davis, and Mann, besides a half dozen different sorts of native fruit. The spots on most of the above varieties are similar to those already described. On the native varieties and on the Talman Sweets the green spots are more common and such brown spots as occur usually have a bright red margin. The appearance on the Talman Sweets is quite similar to that described by Clinton (15) under the name of Fruit Speck. On Snow apples the spots are a deep black and have very definite margins.

LABORATORY INOCULATIONS

During the winter and spring of 1906–07 numerous inoculation experiments were made. The apples used in these experiments were first washed either in alcohol or in a five per cent. solution of formalin. Spores from pure cultures of the fungus were introduced beneath the epidermis by means of a sterile platinum needle. From four to twelve inoculations and an equal number of check punctures were made on each apple. These inoculated apples were placed in moist chambers to await developments. More than a hundred apples have been treated in this manner. Most of these were Baldwins, but Yellow Transparents, Manns, Astrachans, Red Canadas, Greenings, and Porters were also used. Baldwins removed from the culture chambers after two weeks time usually showed little or no contrast between the inoculations and punctures. The same condition was sometimes found at the end of three weeks. After four weeks time there was always a marked contrast (PLATE 31, FIGURE 2). In the punctures the needle path looked practically as clear-cut and fresh as when first made. The inoculations showed on the surface of the apple as brown sunken spots. A study of the underlying tissue showed that the cells around the needle path had shrunken and collapsed making a much larger opening than the original one. The tissue was browned for a radial distance of one to three millimeters (PLATE 30, FIGURE 4). When vascular bundles were near the needle path the browning extended several millimeters farther along their course

than in other directions. Free-hand and microtome sections of the brown tissue of the inoculations showed that but one fungus was present. There was a good growth of this, and its characteristics and its relations to the host cells were the same as are later described for the fungus in the pockets of the host tissue (see page 450). Upon transfer to culture media, inoculation tissue gave pure cultures of the above-mentioned fungus.

The rate of development of the inoculation spots varied greatly with the apple. All of the spots on a particular apple might be as fully developed at the end of two weeks as those on another apple, inoculated on the same day, from the same test-tube and placed in the same moist chamber, were in four weeks. Notes were taken on the acidity, dryness, and texture of such apples, but no conclusion could be drawn as to the cause of the difference in susceptibility of the different apples of the same variety. The results upon other varieties were the same as on the Baldwin except that on the Greenings, Yellow Transparents, Astrachans, and Porters the browning of the spot developed more rapidly. This fact would suggest that a soft tissue and a readily available water-supply are favorable to the rapid development of the fungus.

Attempts were also made to inoculate ripe unspotted apples by spraying spores over their surface and by dropping them into solutions that were full of spores, also by placing small pieces of spore-bearing agar on the lenticels. The apples were placed in a moist chamber and left until decay began. Only negative results were obtained in such cases. The apples used were Porters and Baldwins. Unfortunately, the above test has never been made when the apples were passing through the "after-ripening" stage.

FIELD WORK

From the theoretical as well as the practical standpoint it was of interest to determine when and under what circumstances the fungus gained entrance to the apple and how this infection could be prevented. Spraying experiments made in the summer of 1906 furnished some suggestions in this matter.

Fungicides. — The Bordeaux mixture used in these experiments was made with five pounds each of lime and copper sulphate to fifty gallons of water. The "K. L. B. P." was similar Bordeaux

with kerosene-limoid, as recommended by the Delaware Agricultural Experiment Station (23), containing 15 per cent. of kerosene. The plots consisted of five trees each. The following data were obtained by actual count of the gathered fruit.

Fungicide	Time of spraying	Percentage of picked apples spotted
None		99.7
Bordeaux	May 30	83
"	May 30 and June 8	69
"	June 2 and June 8	72
"	June 2 and June 21	42
"	June 21	56
K. L. B. P.	May 30 and June 8	86
K. L. B. P.	May 30 and June 21	39

These results show that the application made on June 21 was more effective than any other and would suggest that infection usually takes place after that time.

In the summer of 1907 further tests as to the time of infection were made. The Bordeaux used was of the 3–3–50 formula. As the fungus had been found to make a poor growth in alkaline solutions it was thought advisable to try the effect of lime as a spray. Five gallons of lime were added to each fifty gallons of water for this mixture. A resin-lime-solution was also used. It was prepared by adding five pounds of lime and five pounds of resin fish-oil soap to fifty gallons of water. As it was not known that the fungus was the primary cause of the trouble, it seemed possible that some compound with little or no fungicidal value, but which would stick to the fruit as well as the Bordeaux, might have a hardening effect upon the epidermis and thus decrease the spotting. Accordingly calcium phosphate was formed as a precipitate by mixing dilute solutions of lime and sodium phosphate. Two and a half pounds of lime and five pounds of sodium phosphate were added to each fifty gallons of water. The plots consisted of five trees each. The following results were obtained by actual count of the spotted and unspotted apples on the trees at the time of gathering.

Mixture	Time of spraying	Percentage of picked apples spotted
None		33.8
Bordeaux	June 17, June 24, and July 9	1.1
"	June 25 and July 9	1.5
"	July 9 and July 27	1.7
"	July 27	20.4
Lime	June 25 and July 9	16.7
Resin lime	June 25 and July 9	12.9
Calcium phosphate	June 25 and July 9	23.4

The disease was not so serious as the preceding season, but the results were just as marked. While the lime was beneficial and the resin lime even more effective, it can be seen that both were far inferior to Bordeaux. The calcium phosphate was as evident on the foliage and fruit at the close of the season as the Bordeaux, but it seemed to have had but little effect upon the disease. If it had any effect upon the skin of the apple it could not be detected. A study of the results obtained from the use of Bordeaux shows that the application made on July 9 was more effective than any other. It also indicates that applications made as late as July 27 may materially reduce the disease. These facts will be of special interest when viewed in connection with the results obtained in orchard inoculation experiments.

Inoculations. — Throughout the summer a large stock of liquid flask-cultures was kept on hand. The spores from these were added to water or to a one per cent. sugar solution and applied to the trees by means of a bucket-pump spraying outfit. The cultures used were approximately of the same age and the number of them added to a given quantity of water was always the same. The sprayings were all made between four and six o'clock in the afternoon. At each time two trees were thoroughly treated with water containing spores and two others with the sugar solution. These trees were given a second spraying two or three days later. The next week other trees were treated in the same manner. All of the trees were Baldwins. It was not considered necessary to spray the check trees with sterile water as the applications made to the other trees did not amount to more than an ordinary dew, and dews were common during the time of making the experiments. The data secured showed no contrast between the trees sprayed with water and those treated with the sugar solution. The results

are given in the first of the tables below. The data were obtained by actual count of the apples at harvest time.

Only one bearing Baldwin tree was convenient to the laboratory. Inoculation experiments similar to those described above were made on the limbs of this tree. No sugar solution was used, however, and the spores were applied to the individual apple by means of an atomizer. Some half-dozen limbs bearing from six to twelve apples each were treated at a time. The limbs were selected from different portions of the tree so as to eliminate the factors of light and moisture as far as possible. Only one set of limbs was sprayed more than once and this was treated twice a week throughout the season. The sprayings were all made between four and six o'clock in the afternoon. The sprayed apples were not covered or protected in any way. Although the tree was large it is readily seen that plenty of opportunity must have been given for the spores to be carried by the wind from the inoculated apples to others near them. The results obtained from this experiment are given in the second table below.

1

Trees sprayed between	Percentage of picked apples spotted
July 5 and July 27	70.4
July 27 and August 10	43.5
August 10 and September 12	38.9
Checks	33.8

2

Limbs sprayed between	Average number of spots per apple
July 2 and July 15	15
July 15 and July 31	13
July 31 and August 15	11
July 2 and August 15	28
Checks	9

The results varied greatly with the individual limb and tree. It was intended to compare the data obtained with the weather records but it was found at the close of the season that these were in an unsatisfactory condition and could not be relied upon.

Inoculation experiments similar to the above were carried on in the summer of 1908 and results equally as striking were obtained. In spite of the very dry weather in July, inoculations made in that month were far more effective than those made in August.

Other inoculation experiments were made by tying sheets of rubber closely around Baldwin apples and filling the bags thus formed with water that contained an abundance of spores. Check apples were similarly treated with water without the addition of the spores. These sacks were left on the apples three days, and then removed late in the afternoon. The inoculations made in July increased the number of spots by more than a hundred per cent., and those made in August showed a very definite increase over the checks.

One would seem to be justified in concluding from the sets of data above that the possibility of infecting the apples with the fungus in question decreases from July 5 to the close of the season and that the month of July is the time when the majority of the infections naturally occur.

On August 30, September 7, and September 12, 1907, attempts were made to inoculate Baldwins and Northern Spies by introducing the spores under the skin of the apple by means of a sterile platinum needle. Six inoculations and six punctures were made on each apple. The apples were left on the tree till gathering time, October 10. A hard corky growth developed around the needle path in both punctures and inoculations. No difference could be seen in the two at the time of gathering and no change in either was apparent in storage. Tissue from the inoculations when transferred to culture media either gave no growth or a growth of bacteria. The fungus was evidently unable to develop in the column of cider that must have filled the needle path after inoculation. This fact is in agreement with data given later showing that the fungus did not develop on Baldwin cider made from apples gathered the last of August, even when this was diluted to one third its original strength.

CHARACTERISTICS OF THE FUNGUS

In order to learn as much as possible of the nature and identity of the fungus it has been grown upon a large number of culture media. Except where otherwise stated the decoctions used were prepared in the manner prescribed in bacteriological and pathological texts.

In all liquid cultures, except with a few very unfavorable

media, the fungus began its growth in the bottom and on the sides of the vessel. After four or five days the entire surface that was under water was thickly dotted with minute colonies. (This was not true of the sides of Erlenmeyer flasks nor of the upper wall of a slanting test-tube.) The number of colonies was dependent upon the amount of surface and the number of spores introduced rather than upon the quantity of solution. These colonies soon developed into hemispherical gelatinous masses that could not be crushed when placed on a slide under a cover-glass because of the readiness with which they slid from between the glass surfaces (PLATE 31, FIGURE 4). A microscopic study of the material showed that its gelatinous nature was due to the fact that the hyphae upon coming in contact with each other became fastened together. This attachment often extended to a breaking down of the walls between the hyphae and the merging of two cells into one. The result was a peculiarly anastomosed fungous mass. Spores were most abundant on the surface of these masses but were produced throughout the colony. They were hyaline, consisted of from one to five cells and were from 2 to 3 μ wide by 20 to 60 μ long. The hyphae were septate and about 3 μ in diameter. The spores were cut off from the tip of knob-like projections on the side of the hypha as described below for the agar cultures. A few days later these colonies would go to pieces and a growth would soon begin to form on the surface of the liquid. This growth was light-colored at first and of uniform texture throughout, but later had a very definite zonation both as to color and structure (PLATE 33, FIGURE 2). On the surface was a layer of hyaline conidiophores arising from a zone of vertical brown hyphae that formed the upper margin of a dense black stromatic layer. The hyphae of this stroma were thick-walled, abundantly septate, and from 3 to 6 μ in diameter. Beneath it was a less compact layer composed of a mixture of coarse and fine threads. In some cases there was a series of such zones as have just been described. This may have been due to the fact that the liquid had been left on the top of the stroma when examinations of the flask were made. In a five months old flask culture it was noticed that numerous, somewhat hemispherical elevations had developed on the surface of the stroma (PLATE 33, FIGURE 1).

An examination of cross sections of these showed that numerous U-shaped cavities had developed on their surfaces and that where these were present the layer of conidiophores was wanting. These cavities were bordered by rather dense layers of mycelium and contained parallel erect hyphae with thinner-walled and almost isodiametric cells that in some cases gave a suggestion of pre-sporogenous tissue.

In agar cultures the conidia were produced beneath the surface of the agar. One spore would be produced and pushed aside to give way to a second, and this followed by a third and so on indefinitely (PLATE 35, FIGURE 2). In young cultures nearly all of the mycelium was beneath the agar, later a mass of coarse aerial hyphae developed (PLATE 32, FIGURE 5). In such cases a black stromatic layer was formed just beneath the surface of the agar.

Chlamydospores were common in all old cultures.

Conidia germinated rapidly in hanging-drop cultures (PLATE 34, FIGURES 1, 2, 3). Under similar conditions chlamydospores germinated as shown in PLATE 35, FIGURE 4. Each cell of the stromatic mass in old cultures seemed to have the power to send out hyphae when transferred to a fresh medium (PLATE 35, FIGURES 5, 6).

The conidia from very old cultures did not germinate but the chlamydospores and thick-walled hyphae retained their vitality a long time. Germination was secured from chlamydospores in an agar culture that was twenty-six weeks old and in which the medium had been hard and dry for more than five months.

The fungus developed as well in cultures at a temperature of 15 degrees as at 20 degrees but made a poor growth at 30 degrees. It was killed by an exposure for five days to a temperature of 37 degrees. It was evidently not injured by prolonged exposure to low temperatures, as it was repeatedly isolated from apples which had been in cold storage for several months. It was also obtained in culture from an apple which had been exposed for eight days to a temperature varying from — 28 degrees to — 6 degrees C.

RELATION OF THE FUNGUS TO NUTRIENT MEDIA

The fungus grew best on acid media and was very sensitive to sugar in culture solutions. In most culture media that lacked

sugar the fungous growth was white or pink, but where sugar was present as the principal ingredient it was olive or black. The solution given below was found to give a very satisfactory growth of the fungus and was used for all stock cultures. For the sake of convenience it will be referred to hereafter as solution *A*.

Glucose or sucrose	10 grams
Apple bouillon	25 c.c.
Sodium chloride	1 gram
Liebig beef-extract	1 gram
Peptone	2 grams
Water	875 c.c.

The following notes give some of the characteristics of the fungus in various culture media.

In water. — Blocks of infected apple tissue two or three millimeters in diameter gave a good growth of the fungus when dropped into sterile tap or distilled water. In less than a week the fungus had fastened the blocks to the bottom of the test tube and later spores were produced in limited numbers. The hyphae were about 2 μ in diameter, hyaline, and sparingly septate. Spores germinated readily in distilled water, producing hyphae several hundred μ long in a few days.

In peptone beef bouillon. — In this medium the growth was a pinkish white, beginning as colonies on the walls of the flask and later forming a shiny pink layer on the surface of the liquid. There was a fair production of spores. The hyphae were coarser and shorter than those described above.

In glucose bouillon. — Olive colonies developed on the side of the test-tube, followed by a dark olive growth on the surface. Spores were produced in abundance and were always hyaline. The hyphae were thicker-walled and more abundantly septate than in other media.

In solution A (see above). — The growth was more rapid and the spores were produced in greater abundance than in glucose bouillon. The hyphae were hyaline except in the surface growth of very old cultures.

In milk. — The fungus developed only on the surface of the milk. After seven days a slimy pink band of fungous growth would be seen on the walls of the test-tube and a layer of brown

whey two to five millimeters deep would be found on the top of the milk. The remainder of the medium was unchanged and the whey was separated from the milk by means of a film-like layer of curd. At the end of fourteen days the whey had a depth of ten to fifteen millimeters and in three weeks had often nearly reached the bottom of the test-tube. The layer of curd always separated the milk from the whey and in old cultures formed a solid white mass several millimeters deep in the bottom of the tube. Cultures in fermentation-tubes showed that no gas was produced. The hyphae as developed in milk were short, thick, and much branched. Spores often produced other spores by a sort of budding process.

In peptone potato bouillon. — The fungus made a good growth. No browning of the solution was evident in nineteen days but at the end of two months it was browned to a depth of two centimeters and later was browned throughout.

In peptone corn-starch bouillon. — The results were exactly as obtained in peptone potato bouillon except that the browning developed more rapidly.

In potato-starch bouillon. — The fungus made a fair growth. The hyphae were hyaline. The solution was not browned.

In corn-starch bouillon. — The growth was like that in potato-starch bouillon except that in old cultures the hyphae became olive.

In apple bouillon. — Though the tubes were repeatedly inoculated, the fungus did not develop. The bouillon was made from Baldwins gathered the last of August.

On apple cylinders in water. — The fungus made a fair growth. The hyphae were coarse and of a dark olive color. But few spores were produced. The apple tissue became brown in old cultures, a thing which did not happen in the check-tubes.

On potato cylinders in water. — A black slime developed, upon the surface of which were tufts of hyaline hyphae. The spore production was much like that obtained in milk.

On beef bouillon gelatin. — The development was very slow when surface inoculations were made. Liquefaction was scarcely evident in seven days but developed more rapidly after that time. It was crateriform in character. From three to eight weeks were

required for complete liquefaction. In old cultures the liquid was slightly browned. In stab cultures the growth was arborescent [FIGURE 1 (*text*)].

On beet bouillon gelatin. — The hyphae were darker than those in the beef gelatin and the liquefied gelatin was brown from the first.

FIGURE 1. Stab culture of *Cylindrosporium Pomi* on beef bouillon gelatin.

FIGURE 2. Stab culture of *Cylindrosporium Pomi* on beet agar.

On apple bouillon gelatin. — The development was slower than in other gelatins. The fungous mass was olive-black. The gelatin was liquefied and browned.

In beef bouillon agar. — The surface growth was umbonate. It was pink in color and had the appearance of a bacterial culture. Later the growth sometimes became darker at the margins. The hyphae were abundantly septate and the cells often swollen to circular form and to several times their usual width. Typical spores were not produced.

On glycerin agar. — The appearance of the colonies was similar to those on beef agar but they soon turned to an olive color. The hyphae appeared normal and spores were produced in abundance. But few aerial hyphae developed.

On maltose agar. — The colonies were pink at first but later were covered with hyaline aerial hyphae. The development was slow and but few spores were produced.

On beet agar. — In stab cultures the growth was umbonate, and arborescent [FIGURE 2 (*text*)]. The hyphae were hyaline with the exception of an olive mass on the surface in the center of the colony. Spores were produced beneath the agar.

On solution A agar. — The growth was entirely beneath the agar at first. Later an olive stromatic mass developed at the surface and from this were produced numerous aerial hyphae. The spores were abundant and were produced beneath the surface (PLATE 32, FIGURE 5).

Miscellaneous media. — Besides the above media the fungus has been grown on various mixtures and under various conditions in an effort to produce other fruiting forms. Among the substances used were rice, ground whole wheat, hominy, peptone, corn stalks, and various phosphate and potash solutions. On rice and hominy the growth was white on the surface but olive beneath. On ground whole wheat it was black throughout and gradually turned the wheat to a deep brown. In all peptone mixtures the culture medium was browned, the greater concentrations being changed most in color. Sodium ammonium phosphate added to a sugar solution caused a slimy pink growth to develop instead of the usual coarse olive fungus. This was not true of potassium phosphate.

The above culture notes show that while the fungus is responsive to changes in food material it is able to make some sort of growth on almost any medium.

Acidity. Enzymes. — Since the acidity of the cell-contents of the apple had been considered an important factor in the production of the "Stippen," it was thought advisable to test whether the fungus in question increased or decreased the acidity of culture media. Thirty 100 c.c. flasks were thoroughly cleaned as for physiological culture work and 50 c.c. of solution A added to each. After sterilization twenty of these were inoculated with the fungus. All thirty of the flasks were kept under the same conditions for sixteen days. At this time the acidity of the inoculated flasks and those not inoculated was determined by titrations. The large amount of sugar present reduced the sensitiveness of the indicator to such an extent that no definite results were obtained. There had at least been no marked change in acidity.

Neutral litmus milk-tubes were inoculated and were watched for any indication of acidity. The lavender color disappeared only to give place to the brown of the whey.

Some culture material which had originally been solution A but which had had the fungus growing on it for more than five months, produced but an extremely scant growth after sterilization and reinoculation. Tests were made to determine whether the reduction in growth was due to the production of some harmful substance or to lack of food material. 25 c.c. of this used solution were placed in each of fourteen 100 c.c. flasks. To two of these was added as much of each of the original food materials as had been added to an equal quantity of water in the beginning. In another two the peptone content was increased as described above but the solution left otherwise unchanged. The other food constituents were added to other flasks in a similar manner, and two flasks were left unchanged as controls. The flasks were all inoculated with the usual fungus. The ones to which all the original constituents had been added gave a luxuriant growth of the fungus. The flasks to which sugar had been added came next in amount of development and those in which the apple content had been increased came third. The addition of peptone increased the growth but the flasks to which beef extract and sodium chloride had been added gave no better development of the fungus than was obtained in the controls. These results would suggest that the fungus failed to make the usual development in old culture media because of lack of food material rather than from any harmful compound produced, and also that the acidity of the solution must have been decreased by the growth of the fungus. Beef extract and sodium chloride were evidently not used by the fungus in the quantity in which they were added to solution A.

Efforts were made to determine whether the browning that accompanied the fungus in the apple tissue and also in various other culture media was due to an enzyme or other product of the fungus. Strips of sterile uncooked apple tissue were dropped into the old solution A previously described and also into a similar but fresh solution. After three weeks the tissue was unaffected in both of these. This old solution was also added to tubes of milk but no change in color was apparent. Some of the old culture solution

was passed through a Chamberland filter and its effects upon apple tissue tested, but with only negative results.

The toxic effect of malic acid and tannin on the fungus was tested in Van Tieghem cells. Germination was entirely inhibited by a .5 normal solution of malic and greatly retarded by .125 *n* solution. The fungus made a fair growth in the latter solution. With tannic acid, germination was inhibited by a .025 *n* solution and only an abnormal growth was made in .0125 *n* solution. The fungus gave a fair growth in .00625 *n* solution.

According to Alwood and Davidson (24), Baldwins have .039 gram of tannin and .68 gram of acid as malic to each 100 grams of juice from the ripe fruit, *i. e.*, the juice would be about .002 *n* solution of tannin and about a .1 *n* solution of malic acid. These data agree with the fact that the fungus makes a fair growth on ripe apples. They show that any large increase in the acidity of the apple would prevent the development of the fungus in a cider culture. The tannin in the surface zone of the apple is probably greater than the above data would indicate, as tests made by the writer as well as the work of Zschokke (6) show that the tannin content in the hypodermal parenchyma is much greater than in the more deeply seated tissue. It is interesting to note in connection with the extreme sensitiveness of the fruit spot fungus to tannin that Alwood and Davidson (24) found the Baldwin apple to be extremely low in tannin content.

THE RELATION OF THE FUNGUS TO THE HOST

In connection with the other work upon the disease a microscopic study was made of the fungus as found in the tissue of the spots. In the preparation of material several killing agents were used, among these were absolute alcohol, various strengths of chrome-acetic, weak Flemming, Carnoy's fluid, and picro-acetic. The last two were found to be far the most satisfactory. Their superiority lay in the fact that they did not cause the epidermal and closely related cells to become so hard and brittle as the others did. Various contrast stains were tried on the tissue but none found more satisfactory than Delafield's haematoxylin followed by erythrosin. Both the apple tissue and the older threads of the fungus held the haematoxylin

quite persistently. The best results were obtained by staining fifteen or twenty minutes in haematoxylin, washing in acid alcohol until the stain had almost disappeared, transferring to water and then to erythrosin and leaving the slide in the latter stain for several hours. Erythrosin gave fair results when used alone. Free-hand sections were found very serviceable but serial microtome sections were generally used. Various thicknesses of sections were tried. Thin ones were best for a study of the stomata and lenticels, but sections 40 to 60 μ thick were found more satisfactory in tracing the mycelium of the fungus. This is not surprising when we bear in mind the large size of the apple cells and extreme fineness of the mycelium.

Every form and stage of the disease was studied. More than a hundred spots were sectioned and the fungus was found in every spot. This was true of the spots located at stomata and covered by a smooth epidermis as well as of those situated at the lenticels. In the younger stages the fungus had made very scant growth. In several cases it was actually identified in but one or two places in the entire series of sections and these possibly a millimeter or more apart. The threads were hyaline, granular, and apparently non-septate. They were extremely fine, in some cases being less than 1 μ in diameter. They had exactly the same appearance in these young stages of spots as when grown in extremely dilute solutions.

A study of the later stages showed that the fungus had accompanied the browning of the tissue in its spread. In the lenticels of the red spots one sometimes found a band of thick-walled promiscuously arranged cells passing through the organized layers of the lenticel, thus connecting the browned tissue beneath with the break in the epidermis above (PLATE 32, FIGURE 1, and PLATE 34, FIGURE 4). In such cases the fungus was present in both the band of cells and the more deeply seated shrunken tissue. In the green spots the fungus was found both in the groups of brown cells beneath the lenticel and in those a short distance from it (page 433). In many cases it seemed to have remained encysted in the center of these groups of thick-walled cells (PLATE 30, FIGURES 1, 2). In others it had broken through them, spreading deeper into the tissue, browning and killing the cells along its

course (PLATE 30, FIGURE 3). In no case was the fungus definitely traced from one of these pockets to another. Careful search was made for hyphae that had penetrated the cell-walls but none were found. In some cases they seemed at first sight to be within the cells, but a closer observation showed that the cells had collapsed and that the hyphae were in the cavity they had left. The mycelium in the pockets of the host tissue was coarse, septate, thick-walled, and brown, such as was often obtained in the stromatic layers of cultures. From these coarse threads arose fine hyaline apparently non-septate ones which spread out into the apple tissue. Chlamydospores were common on the coarse hyphae but conidia were never found within the apple tissue.

As was previously mentioned, spots that had become much enlarged, sunken, and browned sometimes had a minute elevation in the center (page 433). Sections through these showed that the epidermis had been raised in this manner through the agency of a fungous mass beneath. A dense stroma from 60 to 100 μ in diameter and about 50 μ deep, occupied a pocket beneath the lenticel or stroma. Equally dense layers extended laterally from this between the host cells for a radial distance of 100 to 400 μ. The stromatic mass was hyaline or of a yellowish tint, and was composed of closely woven, septate, thick-walled hyphae that had a diameter of about 5 μ. In spots in which the fungus had not yet broken through the epidermis a somewhat conical fungous mass that seemed to be composed of fine granular hyaline threads arose from the upper surface of the stroma (PLATE 32, FIGURE 2). In older stages this had been forced through the epidermis as a layer of erect hyaline sporophores (PLATE 32, FIGURE 3). The sporophores were extremely thin-walled, usually septate, and either branched or unbranched. The conidia were produced in a manner similar to that already described for the fungus in cultures (PLATE 35, FIGURE 2). They were hyaline, from one- to five-celled, 2 to 2.5 μ in diameter, 15 to 70 μ long, often larger at the basal than at the free end, and were variously curved and contorted.

IDENTITY OF THE FUNGUS

The descriptions of the previous pages together with the various figures to which references have been given furnish

a fairly complete morphology of the fungus in question. In young stages of fruit spots and in all dilute solutions the hyphae are hyaline, granular, apparently non-septate, and are from 1 to 2 μ in diameter. In more concentrated solutions they are usually granular and hyaline, have a diameter of 2 to 3 μ, and are broken up into cells having a length of 30 to 100 μ. Stromatic hyphae and those in the pockets of the host tissue are various shades of yellow and brown in color and are composed of thick-walled, somewhat barrel-shaped cells about 5 μ in diameter and 6 to 20 μ in length. Chlamydospores are a common accompaniment of these coarse threads. They are brown, thick-walled and have a diameter of from 4 to 6 μ. In young liquid and agar cultures conidia are produced from knob-like projections on the side of long, branching, septate, apparently vegetative hyphae. Many conidia are produced from a single one of these projections. The conidia are hyaline, granular, one- to five-celled, from 2 to 2.5 μ in diameter and from 15 to 80 μ in length. In outline they are straight, curved, or sigmoid. They germinate rapidly, sending out one or more hyphae from each cell. In some media the germinating spores produce other spores directly without the development of a mycelium. In old cultures a stroma is produced from which arises a layer of hyaline conidiophores. They are from 20 to 60 μ long and differ from the vegetative hyphae but little save in a reduction in length and branching. The conidia and their manner of production are similar to that described above. Pustule-like cavities having no special peridium develop at stomata and lenticels beneath the epidermis. Later they rupture the epidermis, exposing a layer of hyaline, septate, sparingly branched conidiophores. The conidia are produced from knob-like projections on the conidiophore and have the characteristics given above for spores produced in culture media.

The structure of the pustules and of the spores places the fungus in the genus *Cylindrosporium*. Of the species in this genus enumerated in Saccardo, it bears closest resemblance to *Cylindrosporium Ranunculi* (Bon.) Sacc. This fungus was isolated from leaves of *Ranunculus acris* and *Ranunculus bulbosus* in Italy. So far as can be determined, it differs from the apple fungus in the manner of freeing its spores and probably also in the structure of

its sporophore. From these facts and from the unlikeness of the hosts the writer is not inclined to consider the two fungi identical. For the Fruit Spot fungus he suggests the name *Cylindrosporium Pomi.*

Cylindrosporium Pomi Brooks, sp. nov. — Acervulis pallidis, subeffusis, primo subepidermicis, dein erumpenti-liberis. Conidiis hyalinis, granulosis, filiformibus, rectis vel flexuosis, 15–80 μ × 2–2.5 μ. In fructu *Mali Mali* (L.) Britton, in America Boreali.

SUMMARY AND CONCLUSIONS

1. The writer considers that the facts and indications given justify the conclusion that the Fruit Spot of New Hampshire apples is due to a parasitic fungus, *Cylindrosporium Pomi* Brooks.

2. This fungus gains entrance to the apple in July or early August, a time when the stomata are being torn open and the protecting layers of the lenticels are not yet formed, a season when the metabolism of the apple is extremely great and the transpiration stream necessarily large.

3. The fungus makes its way into the intercellular spaces beneath the stomata and between the cells of the surface zone, obtaining the substances necessary for its existence from the transpiration stream and from the rapidly maturing host cells.

4. If the fruit is attacked before the cells have lost their power to respond to external stimuli the fungus is soon partially surrounded by a layer of brown, thick-walled cells which may serve as a barrier to its further nutrition. In such cases the results are not altogether unlike those obtained from a minute puncture or an insect sting.

5. If, however, the fungus attacks the host cells when they are nearly mature, it finds conditions more favorable for its development, because the cell sap furnishes more satisfactory food material and the cells are at the same time unable to respond to its presence. The result is a more vigorous development of the fungus and a rapid browning and drying of the host tissue.

6. The chlamydospores and sclerotial masses of the fungus are the probable agencies in carrying the disease through the winter.

7. Conidia have not been found on the host in the fall. They probably develop from sclerotia and pycnidia in the following

spring on apples that have lain on the ground over the winter, and thus become the agency in starting the disease the next season.

8. Spraying with Bordeaux is a preventive for the disease. Applications made late in June or early in July are as effective as those made earlier in the season.

9. By his references to the work reported from other stations the writer would not be understood to imply that the disease here under special consideration is *identical* with that described from any other section. However, he does not find anything in some of these reports to show that the Fruit Spot which is common in New Hampshire *may* not sometimes have been included along with the Fruit Pit in these descriptions. Further, this study leads the writer to the conclusion that because particular pathological conditions may originate without the presence of any foreign agency, this should not be taken as proof that very similar results may not be due to the presence of a parasitic fungus in the host tissue.

The writer wishes to acknowledge his indebtedness to Prof. H. H. Whetzel of Cornell University, Prof. W. J. Morse of the Agricultural Experiment Station of Maine, Dr. J. B. Dandeno of Michigan State Agricultural College, Prof. W. T. Macoun of the Central Experimental Farm, Ottawa, Canada, and Prof. C. P. Lounsbury of the Department of Agriculture, Cape Town, Africa, for specimens of spotted fruit.

LITERATURE CITED

1. **Sorauer, P.** Obstbaumkrankheiten, 100. Berlin, 1879.
2. **Fries, E.** Systema Mycologium **3**: 504. 1832.
3. **Reichelt, K.** Pomolog. Monatshefte **1884**: 335. 1884.
4. **Frank, A. B.** Die Krankheiten der Pflanzen, 588. 1880.
5. **Wortmann, J.** Ueber die sogenannten "Stippen" der Aepfel. Landw. Jahrb. **21**: 663–675. 1892.
6. **Zschokke, A.** Ueber den Bau der Haut und die Ursachen der verschiedenen Haltbarkeit unserer Kernobstfrüchte. Landw. Jahrb. der Schweiz **11**: 153–197. 1897.
7. **Cobb, N. A.** Brown or Bitter Pit. Agric. Gaz. N. S. Wales 9: 683. 1898.
8. **Craig, J.** Dry Rot, Brown Spot of Baldwins, Spot of apples. Rep. Canada Exp. Farms, 1896 and 1899.

9. **Selby, A. D.** Brown spots beneath the skin of apple. Bull. Ohio Agric. Exp. Sta. 79: 135. 1897.

10. **Jones, L. R.** A spot-disease of the Baldwin apple. Rep. Vt. Agric. Exp. Sta. **5**: 133–134. 1891.

11. **Jones, L. R.** The Brown Spot of the apple. Rep. Vt. Agric. Exp. Sta. **12**: 159–164. 1898.

12. **Stewart, F. C.** Is the Baldwin Fruit Spot caused by fungi or bacteria? Bull. N. Y. Agric. Exp. Sta. **164**: 215–219. 1899.

13. **Stewart, F. C.** Fruit Spot. Bull. N. Y. Agric. Exp. Sta. **191**: 296–297. 1900.

14. **Clinton, G. P.** Baldwin Spot. Rep. Conn. Agric. Exp. Sta. **1903**: 302.

15. **Clinton, G. P.** Fruit Speck. Rep. Conn. Agric. Exp. Sta. **1905**: 264.

16. **Longyear, B. O.** Fruit Spot. Special Bull. Mich. Agric. Exp. Sta. **25**: 14. 1904.

17. **Lamson, H. H.** The Brown Spot of Baldwins. Bull. N. H. Agric. Exp. Sta. 27, 45, 65, 101.

18. **Pick, H.** Bot. Centralbl. **16**: 281–284; 314–318; 343–347; 375–383. *pl. 1.* 1883.

19. **Pfeiffer, O.** Ann. Oenol. **5**: 271–315. 1875.

20. **Bigelow, Gore, & Howard.** Studies on apples. Bull. Bur. Chem. U. S. Dept. Agric. **94**: 1–100. *pl. 1–5.* 1905.

21. **Morse, F. W.** Chemical changes in apples during storage. Bull. N. H. Agric. Exp. Sta. 93: 82–88. 1902.

22. **Otto, R.** Landw. Versuch-Stat. **56**: 427–439. 1902.

23. **Close, C. P.** Bull. Del. Agric. Exp. Sta. **68**: 1–23. 1905.

24. **Alwood, Davidson, & Moncure.** The chemical composition of apples and cider. Bull. Bur. Chem. U. S. Dept. Agric. **88**: 1–46. 1904.

NEW HAMPSHIRE COLLEGE,
DURHAM, N. H.

Explanation of plates 29-35

PLATE 29

FIG. 1. Baldwin showing young stages of the Fruit Spot.

FIG. 2. Baldwin showing later stages of the Spot.

PLATE 30

FIGS. 1 and 2. Section through green spots of Baldwins showing a browning in the surface cells and pockets in the adjacent tissue. The fungus can be plainly seen in some of the largest pockets.

FIG. 3. Section through a green spot of a badly withered Baldwin, showing the thick-walled cells of the surface zone from which has later extended the large mass of shrunken brown cells beneath. The fungus can be seen in the pockets in this shrunken tissue.

FIG. 4. A cross-section of a thirty-four days old inoculation on a Baldwin. The mycelium may be seen in the needle path and also closely pressed against the walls of the withering cells.

PLATE 31

FIG. 1. A cross-section of an apple to show the location of the large bands of conducting tissue.

FIG. 2. Inoculations and punctures from a Baldwin after fifty days. The two at the right are inoculations.

FIG. 3. A section of an apple of which the cell tissue in the region of the vascular system is browned.

FIG. 4. A section of a typical colony from the walls of a ten days old culture of solution A. The lower side as shown in the plate was attached to the wall of the test tube.

PLATE 32

FIG. 1. A section through an early stage of a red spot. The opening through the epidermis has been enlarged by a breaking of the tissue in cutting. At the right the small regular cells of the lenticel are replaced by large thick-walled ones. In the pocket that extends into these from above may be seen the granular hyphae of the fungus.

FIG. 2. A late stage of the Fruit Spot, showing the stromatic layer of the fungus with a conical mass of immature sporophores above it.

FIG. 3. A later stage of the spot showing the stroma, the shrunken tissue beneath, and the sporophores pushing through the lenticel above.

FIG. 4. A lenticel of an apple with normal tissue beneath it.

FIG. 5. Fungus as grown in agar Petri cultures.

PLATE 33

FIG. 1. A section of one of the minute elevations from the stroma of a five months old flask culture. The pustule-like cavities are shown in the upper portion.

FIG. 2. A cross-section of a stroma from a liquid flask culture showing the layer of conidia and conidiophores.

PLATE 34

FIG. 1. Spores from cultures in solution A.

FIG. 2. The same spores after remaining twenty-one hours in Van Tieghem cells.

FIG. 3. The same spores after forty-two hours.

FIG. 4. A drawing of a section through an early stage of a fruit spot.

PLATE 35

FIG. 1. Conidia from a pustule such as is shown in FIG. 3, PLATE 32.

FIG. 2. Spore production in solution A agar after four days.

FIG. 3. Chlamydospores from an old culture.

FIG. 4. Germinating chlamydospores.

FIG. 5. Olive-brown hyphae from a six weeks old liquid culture after one day in a Van Tieghem cell.

FIG. 6. A similar hypha after two days in a Van Tieghem cell.

FIG. 7. A sketch of a portion of the vascular system of an apple.

Notes on Philotria Raf.

Per Axel Rydberg

When trying to determine the Rocky Mountain specimens of *Philotria*, I happened to run across Caspary's very interesting paper on "Die Hydrilleen" in the Jahrbücher für wissenschaftliche Botanik.* It is rather surprising that very little has been written in this country on this American genus, when Caspary devotes over 50 pages to this genus and 137 pages to the tribe *Hydrilleae*. The genus needs, however, a good deal of more critical study in the field and these notes are written to call attention to this very interesting genus of water plants. I shall here give a short recapitulation of its history.

The genus was first described in Michaux's Flora Boreali-Americana † under the name *Elodea*, which, however, is antedated by *Elodes* Adans. Here the genus is characterized as having hermaphrodite flowers with three stamens, thick filaments, cordate anthers, and three bifid styles. The leaves in *E. canadensis* Michx. are described as being oblong and obtuse.

Muhlenberg ‡ referred the plant to the Old World *Serpicula verticillata*, described the staminate flowers as 4-merous, and added a variety *angustifolia* with narrow leaves.

The next description we find in Pursh's Flora Americae Septentrionalis § as *Serpicula occidentalis*. The description here agrees with that in Michaux's Flora, except that the leaves are described as linear, acute, and finely serrulate.

Rafinesque ‖ gave no description, but merely changed Michaux's *Elodea* to *Philotria* on account of the earlier *Elodes* of Adanson.

Nuttall ¶ proposed a new genus *Udora* and cited *Elodea*

---

* 1 : 377–513. 1858.
† 1 : 20. 1803.
‡ Cat. Pl. Am. Sept. 84. 1813.
§ 1 : 23 and 33. 1814.
‖ Am. Monthly Mag. 2 : 175. 1818.
¶ Gen. N. Am. Pl. 2 : 242. 1818.

Michx. as a synonym but described the plant as dioecious, the staminate flowers with nine stamens in two series, the inner of which has three stamens, and the pistillate flowers with three sterile filaments and three ligulate bifid stigmas. He added further: "flowers very small and evanescent, the female emerging; the male migratory, breaking off connection usually with the parent plant, it instantly expands to the light, the anthers also burst with elasticity and the granular pollen vaguely floats upon the surface of the water." He described the leaves as oblong-linear, minutely serrulate, and partly obtuse.

Torrey* described *Udora* as being polygamous. "STERILE FL[OWERS]. Stamens 9: anthers oval, nearly sessile. PERFECT FL[OWERS]. Tube of the perianth produced above the ovary into a very long slender tube. Stamens 3–6: filaments short, subulate; anthers oblong, innate; the cells parallel, distinct . . . stigmas 3, large, spreading, oblong-cuneiform, 2-lobed." He described the leaves as varying from oblong-ovate to lanceolate-linear.

How are these conflicting descriptions to be reconciled? Have some of the authors mentioned been mistaken? Are there more than one species confused or is *Philotria canadensis* (Michx.) Britton such a variable plant both as to flowers and leaves? If more than one species, are they all polygamo-dioecious with three kinds of flowers: staminate with very short calyx-tube and 9 stamens; pistillate with long tube and no stamens or merely rudimentary filaments; and hermaphrodite flowers with long tube and 3–6 stamens? These are questions to be answered and botanists who have a chance to study the plants in the field will be well paid in investigating these interesting water-weeds. The writer would also be very thankful for material.

Let us see what is the present knowledge of the genus. Let us take up the different species proposed and the different descriptions, in the order they appear.

ELODEA CANADENSIS Michx. Fl. Bor.-Am. 1: 20. 1803.

This was described as having hermaphrodite flowers with 3 stamens and bifid stigmas, and oblong, obtuse leaves. Is there such a plant? Caspary, who saw the original Michauxian material at Paris, stated that the two flowers found there were hermaphrodite

* Fl. N. Y. 2: 264. 1843.

as described. He stated also that he had examined eight specimens collected by Moser in Pennsylvania, in 1832, and one by Schweinitz. These were all hermaphrodite, with from 2 to 7 stamens. In the Torrey herbarium there is a specimen of Moser's collection, but the tops of the flowers are broken off. In this specimen, however, the leaves are not oblong and obtuse, as described by Michaux, but linear and acute. There are other specimens in our herbaria with oblong or oblong-ovate leaves. One of these represents *Udora canadensis* of Torrey's Flora of New York from Torrey's sets distributed in connection with that publication. The flowers are hermaphrodite, as Torrey described his fertile flowers. Torrey stated that he had not seen any living sterile flowers but drew his description of them from material collected by Engelmann. This material I shall discuss later. There are other broad-leaved specimens, viz.: from Watertown, N. Y., 1834, *Dr. Gray;* East Haven Pond, Conn. (collector not given); Thousand Islands, N. Y., July 16, 1889, *John Northrop;* Prior's Lake, Minn., 1891, *C. A. Ballard;* Fish Creek, Sylvan Beach, N. Y., *L. M. Underwood 3211;* Waynesborough, Va., 1897, *W. A. Murrill;* Chilson Lake, N. Y., 1900, *Dr. & Mrs. N. L. Britton;* but all these have no flowers or the flowers are in such condition that it is impossible to say whether they are pistillate or hermaphrodite. None of these specimens has any sessile staminate flowers. Then the question arises: is the broad-leaved, *i. e.*, the typical *Philotria canadensis* (Michx.) Britton always hermaphrodite? Nobody, so far as I can find, has described any staminate flowers in connection with broad, oblong leaves.

SERPICULA VERTICILLATA Muhl. Cat. Pl. Am. Sept. 84. 1813.

This is described as monoecious and 3-androus, but the statement that the sepals and petals of the staminate flowers are four must have been an error or else Muhlenberg's specimens were abnormal. What it really was is of little consequence, as it is not *Serpicula verticillata* L.

SERPICULA VERTICILLATA ANGUSTIFOLIA Muhl. Cat. Pl. Am. Sept. 84. 1813.

This is of interest as it is the first name as far as known applicable to a form evidently distinct from *Elodea canadensis* Michx.

As far as I know, it is dioecious. The leaves are narrowly linear, acute, usually over 1 cm. long and about 1 mm. wide. The spathe of the staminate plant is 2–3 mm. long, subsessile, ovoid; the sepals and petals are elliptic, 2 mm. long; stamens 9; anthers oblong, about 1 mm. long. Spathe of pistillate plant linear-tubular, about 1 cm. long; tube of the flower 3–8 cm. long; sepals oblong, fully 1.5 mm. long; stamens none (only rudimentary filaments); stigmas 3, linear (whether 2-cleft or not cannot be determined). The name *Philotria angustifolia* was given to it in the Torrey herbarium. This name was taken up by me in my Flora of Colorado, but there applied to another species. It is represented by the following specimens: west side of 3d Ave., New York City, 1851, *Dr. Torrey & Dr. Gilman* [later than the publication of Torrey's Flora of New York], staminate and pistillate flowers; pool along Hudson River, below Hastings, 1895, *E. P. Bicknell*, pistillate flowers; brook from Fairy Dell, near Quogue, Long Island, 1885, *E. G. Knight*, pistillate flowers; Harrisburg, Pa., 1895, *J. K. Small*, sterile; Baltimore Co., Md., 1890, *K. A. Taylor*, pistillate flower (?), but only tube left; McCall's Ferry, Pa., 1893, *J. K. Small*, sterile. To this may also be counted the specimen of Moser mentioned above in the Torrey herbarium, which has however somewhat broader leaves. If this had hermaphrodite flowers, like the specimens seen by Caspary, this species may have all three kinds of flowers.

SERPICULA OCCIDENTALIS Pursh, Fl. Am. Sept. 1: 33. 1814.

This agrees with *Elodea canadensis* Michx. in description, except that the leaves are described as linear and acute. There is, however, no specimen with hermaphrodite flowers and linear leaves in our collections, unless that of Moser had such.

UDORA CANADENSIS Nutt. Gen. N. Am. Pl. 2: 242. 1818.

This is described as being dioecious, having staminate flowers with 9 stamens, pistillate ones with 3 sterile filaments and 3 ligulate, bifid stigmas, and oblong-linear, partly obtuse leaves.

This description fits a form somewhat similiar to the plants referred to *Elodea canadensis* Michx., but with more narrowly oblong, often somewhat acutish leaves. It is represented by the following specimens: Clifton, Passaic Co., N. J. 1891, *Geo. L.*

Nash, staminate and pistillate flowers; Buffalo, N. Y., *G. W. Clinton*, pistillate; Kendall, Orleans Co., N. Y., 1878, *H. S. Burnett*; Lake View, Jefferson Co., 1891, *Underwood*, pistillate; Fish Creek, Oneida Lake, N. Y., 1890, *Underwood*, pistillate; Wallace Switch, Va., 1892, *J. K. Small*, sterile. Nash's specimens are the only ones that have staminate flowers. The spathe is like that of *P. angustifolia*, but larger, 5–6 mm. long, the anthers in the unopened flower 2–2.5 mm. long. The *Udora canadensis* Nutt. may represent the unisexal form of *Elodea canadensis* but all these unisexual plants have narrower leaves than the specimens referred to the latter. It may represent a distinct species; if so, its name would be **Philotria Nuttallii,** as *Anacharis Nuttallii* Planch. was mostly based on this form.

ANACHARIS ALSINASTRUM Babingt. Ann. & Mag. Nat. Hist. II. 1: 85. 1848.

This was described from specimens collected at Foxton Locks, near Market-Harborough, Leicester, England. The plant was at first looked upon as indigenous, but is now generally regarded as introduced. Babington's specimens, like all those collected in Europe, have only pistillate flowers; staminate and hermaphrodite ones are wholly unknown. The flowers have three oblong sepals and petals, three sterile filaments and club-shaped entire or merely emarginate stigmas, and oblong, obtusish leaves, sometimes as broad as those of *Elodea canadensis* Michx., sometimes hardly broader than those of *Udora canadensis* Nutt. or *Anacharis Nuttallii* Planchon, but always obtuse. This may be the pistillate form of *Elodea canadensis*, if this is polygamo-dioecious. The specimens in our herbaria are all European: canal near Hasselt, Villefranche, Rhône, France, 1874, *A. Méhu*; Lago di Manlova, Maggio, Italy, 1895, *De-Toni*; Göta Elf, Sweden, 1899, *C. G. H. Thedenius*; Ostende, Belgium, 1871, *E. Cosson*; Spree, Berlin, Germany, 1877, *Mueller & Retzdorff*; Leigh Park, Hampshire, England, 1850. I collected it myself in the 1870's at Skara, Sweden.

ANACHARIS NUTTALLII Planch. Ann. Sci. Nat. Bot. III. 11: 74. 1849.

This is based on *Udora canadensis* Nutt. Planchon distinguished it from *A. Alsinastrum* by the oblong-linear, not oval-

oblong leaves, and the bifid, instead of emarginate, stigmas. Caspary includes herein also the specimens collected at St. Louis, Mo., and distributed as *Udora verticillata? minor* Engelm., but this I believe to be distinct. See below.

ANACHARIS CANADENSIS Planch. Ann. Sci. Nat. Bot. III. **11**: 75. 1849.

Planchon's description differs considerably from that of Michaux and he could not have had the same plant in mind. The plant is said to be dioecious, the spathe of the staminate flowers ventricose-obovate and short-peduncled, and the staminate flowers themselves apetalous. It was described from staminate specimens collected by Drummond in Saskatchewan and imperfect pistillate specimens from Canada collected by Cleghorn. There is no evidence that the two belonged to the same species, but the staminate plants of Drummond must be regarded as the type. On these was based

ELODEA PLANCHONII Casp., Jahrb. Wiss. Bot. **1**: 468. 1858.

This is evidently a very distinct species and unique in the two characters given. The staminate flowers are much larger than in the other North American species, but the pistillate ones are as small as those of *Philotria minor* Small (*Udora verticillata minor* Engelm.). The leaves are usually as narrow as in that species, and in *Philotria angustifolia* (Muhl.) Britton. In my Flora of Colorado I referred the specimens of that state to those species. Having discovered my mistake, I shall here give a fuller description of the plant:

Philotria Planchonii (Casp.) Rydb.

Dioecious water-plant; stem slender, 1–5 cm. long; leaves in 3's or the lower opposite, 7–15 mm. long, oblong to lance-linear, acutish; spathe of the staminate flowers obovoid-clavate, nearly 1 cm. long, on a peduncle 5–10 mm. long; flowers short-pediceled; sepals elliptic, 5 mm. long; petals lacking; stamens 9, anthers oblong, 3–4 mm. long, subsessile; spathe of the pistillate plant linear or lance-linear, sessile, 2-cleft at the apex; calyx-tube slender, 3–5 cm. long; sepals and petals linear, about 3 mm. long; styles 3, linear; stamens none.

The following specimens belong here: Seven Mile Lakes, Albany County, Wyo., 1901, *Leslie N. Gooding 597*, staminate; Fish

Hatchery, Wyo., 1898, *Aven Nelson 5374*, pistillate; Lee's Lake, Colo., 1897, *C. S. Crandall 2423*, staminate; 1896, *2421*, fruit; Rio Grande, Alamosa, Colo., 1896, *C. L. Shear 3746*, staminate and pistillate; Wadsworth, Nev., 1887, *Tracy & Evans 475*, pistillate.

APALANTHE SCHWEINITZII Planch. Ann. Sci. Nat. Bot. III. **11**: 76. 1849.

Planchon distinguishes the genus *Apalanthe* from *Anacharis* by the hermaphrodite instead of dioecious flowers. Of how little value these characters are as generic distinctions may easily be settled by field work. From the description, this must be identical with *Serpicula occidentalis* Pursh. Of course, it is also *Elodea Schweinitzii* Casp. Jahrb. Wiss. Bot. **1**: 468. 1858.

ELODEA LATIFOLIA Casp.; Jahrb. Wiss. Bot. **1**: 467. 1858.

This was described from sterile material collected by Schweinitz. It was characterized by broad ovate-oblong leaves and rounded toothed stipules. Why is this not the typical *Elodea canadensis* Michx.?

UDORA VERTICILLATA ? MINOR Engelm.; under *Anacharis Nuttallii* Casp. Jahrb. Wiss. Bot. **1**: 465. 1858.

As stated before, Caspary included in *Anacharis Nuttallii* the specimens collected by Engelmann near St. Louis, Mo., and he cited Engelmann for the main part of the description of the flowers. I think, however, that Engelmann's plant is distinct from both the plant described by Nuttall and the plant collected by Torrey in New Jersey, which is the only one cited by Planchon. It is closely related to *Philotria angustifolia* (Muhl.) Britton, differing mostly in the size of the plant and the flowers. The spathe of the staminate plant is subglobose, 2 mm. long; sepals ovate; petals narrowly ovate, 1.5 mm. long; stamens 9, anthers scarcely 1 mm. long; spathe of the pistillate plant linear-tubular, 1 cm. long, 0.5 mm. thick; tube of the flower very slender, 3–6 cm. long; sepals and petals ovate, 1–1.5 mm. long; stigmas 3, club-shaped, bifid; leaves linear, acute, 5–8 mm. long, 1 mm. wide. This species is represented by the following specimens: St. Louis, Mo., 1845, *Engelmann*, pistillate and staminate plants, 3 sheets; Banks of Mississippi, Oquawka, Ill., *H. N. Patterson*, pistillate; Lexing-

ton, Ky., *Robert Peters*, pistillate; Linn County, Kansas, 1897. *G. L. Clothier*, sterile; Fox Lake, Wayne Co., Ohio, 1899, *Selby & Duvel 1321*, sterile; Milwaukee, Wis., 1887, *H. E. Hasse*, pistillate, long-leaved. The form has been raised to specific rank under the name

PHILOTRIA MINOR (Engelm.) Small, Fl. SE. U. S. 47. 1903.

Besides these, there seems to be another undescribed species:

Philotria linearis sp. nov.

Apparently dioecious, stem slender, 3–5 dm. long; leaves linear, acute, about 1 cm. long, scarcely 1 mm. wide, entire; spathe of the staminate plant peduncled; peduncle 3–4 mm. long; body ovate, about 3 mm. long; sepals broadly oval, 2.5 mm. long; petals oblong; stamens 9, anthers oblong, 2 mm. long.

The type was collected in swamps bordering on Cumberland River, vicinity of Nashville, Tenn., by Dr. A. Gattinger. The pistillate plant is unknown unless a specimen collected at Center City, Minn., in 1892, by B. C. Taylor, belongs here. It resembles the pistillate plant of *P. minor*, but the leaves are longer and more flaccid; the tube of the flower is 4–6 cm. long; the sepals and petals more oblong.

P. linearis resembles *P. Planchonii* in having stalked staminate spathe, but differs in that the spathe itself is much smaller and abruptly contracted at the base, the sepals are of about half the size of those of that species, and petals are present.

With the material on hand it is almost impossible to determine how many species are found in this country and their limitation. From the present knowledge I would think the number to be at least six. Of these I append here a temporary key, wishing to call the attention of the botanists of this country to the confusion existing and to give a tentative basis on which to build further study.

Leaves oblong or ovate-oblong, mostly obtuse; staminate flowers unknown.
P. canadensis.

Leaves linear or oblong, mostly acute; hermaphrodite flowers unknown.
Staminate spathe sessile.
Leaves oblong or lance-oblong, 2–3 mm. wide, spathe of staminate flowers 5–6 mm. long; anthers 2–2.5 mm. long. *P. Nuttallii.*
Leaves linear, 1 mm. wide or less; staminate spathe 2–3 mm. long; anthers about 1 mm. long.
Leaves 1 cm. long or more; sepals and petals 1.5–2 mm. long. *P. angustifolia.*

Leaves 5–8 mm. long; sepals and petals 1–1.5 mm. long.
P. minor.

Staminate spathe peduncled.

Staminate spathe ovoid, abruptly contracted at the base; sepals 2.5 mm. long; petals present. *P. linearis.*

Staminate spathe obovoid, tapering at the base; sepals of the staminate flowers 5 mm. long; petals lacking. *P. Planchonii.*

The synonymy would be as follows:

PHILOTRIA CANADENSIS (Michx.) Britton, Science II. 2: 5. 1895.

Elodea canadensis Michx. Fl. Bor.-Am. 1: 20. 1803.

? Anacharis Alsinastrum Babingt. Ann. & Mag. Nat. Hist. II. 1: 85. 1848.

Elodea latifolia Casp. Jahrb. Wiss. Bot. 1: 467. 1858.

PHILOTRIA NUTTALLII (Planch.) Rydb. [See above.]

Serpicula verticillata Muhl. Cat. Pl. Am. Sept. 84. 1813. Not *S. verticillata* L. f. 1781.

Udora canadensis Nutt. Gen. N. Am. Pl. 2: 242. 1818.

Anacharis Nuttallii Planch. Ann. Sci. Nat. Bot. III. 11: 74. 1849.

PHILOTRIA ANGUSTIFOLIA (Muhl.) Britton; Rydb. Bull. Agr. Exp. Sta. Colo. 100: 15. 1906.

Serpicula verticillata angustifolia Muhl. Cat. Pl. Am. Sept. 84. 1813.

? Serpicula occidentalis Pursh, Fl. Am. Sept. 1: 33. 1814.

? Serpicula canadensis Eat. Man. 391. 1829. [Ed. 5.]

? Apalanthe Schweinitzii Planch. Ann. Sci. Nat. Bot. III. 11: 76. 1849.

? Elodea Schweinitzii Casp. Jahrb. Wiss. Bot. 1: 468. 1858.

PHILOTRIA MINOR (Engelm.) Small. Fl. SE. U. S. 47. 1903.

Udora verticillata ? minor Engelm.; Casp. (synonym under *Anacharis Nuttallii*) Jahrb. Wiss. Bot. 1: 465. 1858.

PHILOTRIA LINEARIS Rydb. [See above.]

PHILOTRIA PLANCHONII (Casp.) Rydb. [See above.]

Anacharis canadensis Planch. Ann. Sci. Nat. Bot. III. 11: 75. 1849.

Elodea Planchonii Casp. Jahrb. Wiss. Bot. 1: 468. 1858.

NEW YORK BOTANICAL GARDEN.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1908)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

This Index is reprinted monthly on cards, and furnished in this form to subscribers, at the rate of one cent for each card. Selections of cards are not permitted; each subscriber must take all cards published during the term of his subscription. Correspondence relating to the card-issue should be addressed to the Treasurer of the Torrey Botanical Club.

Anderson, J. P. Iowa *Erysiphaceae*. Proc. Iowa Acad. Sci. **14**: 15–46. *pl. 1–3*. [Au 1908.]

Bartlett, H. H. The type locality of *Sphagnum Faxonii*. Rhodora **10**: 113, 114. 15 Jl 1908.

Blumer, J. C. Distributional features of some southwestern shrubs. Plant World **11**: 117–123. [Jl] 1908.

Brand, A. *Polemoniacea* peruviana. Bot. Jahrb. **42**: 174, 175. 28 Jl 1908.

Huthia coerulea gen. et sp. nov.

Buchanan, R. E. Notes on the algae of Iowa. Proc. Iowa Acad. Sci. **14**: 47–84. [Au 1908.]

Bushee, G. L. The occurrence and rate of protoplasmic streaming in greenhouse plants. Bot. Gaz. **46**: 50–53. 23 Jl 1908.

Chodat, R. *Polygalaceae* andinae. Bot. Jahrb. **42**: 97–104. 28 Jl 1908.

10 species and many varieties described as new.

Clark, G. H. Conditions unfavorable to the resumption of growth by the dormant embryo in seeds. Ottawa Nat. **22**: 102–104. 6 Au 1908.

Cockerell, T. D. A. Descriptions of Tertiary plants. Am. Journ. Sci. **26**: 65–68. Jl 1908.

Several new species from Florissant.

Cockerell, T. D. A. Florissant: a Miocene Pompeii. Pop. Sci. Mo. **73**: 112–126. Jl 1908. [Illust.]

Cogniaux, A. *Melastomaceae* peruvianae. Bot. Jahrb. **42**: 131–148. Jl 28 1908.

Many new species described.

Cogniaux, A. *Cucurbitaceae* peruvianae. Bot. Jahrb. **42**: 173, 174. 28 Jl 1908.

Guraniopsis longipedicellata gen. et sp. nov.

Conard, H. S. Homology of tissues in ferns. Pro. Iowa Acad. Sci. **14**: 85–87. [Au 1908.]

Coulter, J. M. The embryo sac and embryo of *Gnetum Gnemon*. Bot. Gaz. **46**: 43–49. *pl. 7*. 23 Jl 1908.

Cushman, J. A. A synopsis of the New England species of *Micrasterias*. Rhodora **10**: 97–111. 15 Jl 1908.

New varieties and new combinations published.

Davis, B. M. Polar organization of plant cells. Am. Nat. **42**: 501–504. [Au] 1908.

Dudgeon, W. A study of the variation of the number of ray flowers of certain *Compositae*. Proc. Iowa Acad. Sci. **14**: 89–106. [Au 1908.] [Illust.]

Durand, E. J. The development of the sexual organs and sporogonium in *Marchantia polymorpha*. Bull. Torrey Club **35**: 321–335. *pl. 21–25*. 30 Jl 1908.

Gates, R. R. A study of reduction in *Oenothera rubrinervis*. Bot. Gaz. **46**: 1–34. *pl. 1–3*. 23 Jl 1908.

Gilg, E. *Marcgraviaceae* Americae tropicae. Bot. Jahrb. **42**: 124–128. 28 Jl 1908.

New species *Marcgravia* (3), *Norantea* (5), and *Souroubea*.

Gow, J. E. Studies in karyokinesis. Proc. Iowa Acad. Sci. **14**: 107–113. *f. 1–46*. [Au 1908.]

Gow, J. E. Studies in *Araceae*. Bot. Gaz. **46**: 35–42. *pl. 4–6*. 23 Jl 1908.

Gürke, M. *Pilocereus Schottii* (Engelm.) Lem. Monats. Kakteenk. **18**: 99, 100. 15 Jl 1908. [Illust.]

Harms, H. *Leguminosae* andinae. Bot. Jahrb. **42**: 88–97. 28 Jl 1908.

10 new species and the new genus *Fiebrigiella*.

Harms, H. *Passifloracea* peruviana. Bot. Jahrb. **42**: 130, 131. 28 Jl 1908.

P. macrochlamys sp. nov.

Harms, H. *Araliaceae* peruvianae. Bot. Jahrb. **42**: 148–162. 28 Jl 1908.
Many new species described.

Harper, R. M. Some native weeds and their probable origin. Bull. Torrey Club **35**: 347–360. 30 Jl 1908.

Harper, R. M. Suggestions for future work on the higher plants in the vicinity of New York. Torreya **8**: 153–164. 29 Jl 1908.

Hartley, C. P. Some apple leaf-spot fungi. Science II. **28**: 157–159. 31 Jl 1908

Hayek, A. von. *Verbenaceae* austro-americanae. Bot. Jahrb. **42**: 162–173. 28 Jl 1908.
Many new species described.

Heimerl, A. *Nyctaginaceae* austro-americanae. Bot. Jahrb. **42**: 73–81. 28 Jl 1908.
Species described as new in *Mirabilis* (3), *Colignonia* (2), *Pisonia* (2).

Hemsley, W. B. The history of three casual dodders. Jour. Bot. **46**: 241–247. *pl. 493*. Au 1908.
Includes synonymy of *Cuscuta Gronovii*.

Hennings, P. Fungi bahiensis. Hedwigia **47**: 266–270. 16 My 1908.
A new genus (*Epheliopsis*) and many new species from Brazil.

Keller, R. *Hyperica* (Sect. *Brathys*) andina. Bot. Jahrb. **42**: 129–130. 28 Jl 1908.
H. Weberbaueri sp. nov.

Lacouture, C. Clé analytique et synoptique des quarante et quelques sous-genres de l'ancien *Lejeunea*. (Libert). Rev. Bryol. **35**: 101–114. *f. 1–44*. Jl 1908.

Lindau, G. Lichenes peruviani, adjectis nonnullis columbianis. Bot. Jahrb. **42**: 49–60. 28 Jl 1908.
4 new species described.

Lindau, G. *Acanthacea* peruviana. Bot. Jahrb. **42**: 173. 28 Jl 1908.
Siphonoglossa peruviana sp. nov.

Lloyd, F. E. Extra-floral nectaries in the cacti. Plant World **11**: 138–140. [Jl] 1908.

Lloyd, F. E. Stomata as regulators of transpiration. Plant World **11**: 131–138. [Jl] 1908.

Lloyd, J. U. & C. G. *Hydrastis canadensis*. Drugs and Medicines of North America **1**: 76–184. *pl. 8. + f. 27–43*. 1884–1885.
Reprinted in Bulletin of the Lloyd Library No. 10. 1908.

Osterhout, W. J. V. On plasmolysis. Bot. Gaz. **46**: 53–55. 23 Jl 1908.

Pammel, L. H., & Fogel, E. D. A catalogue of the poisonous plants of Iowa. Proc. Iowa Acad. Sci. **14**: 147–176. *3 maps.* [Au 1908.]

Parish, S. B. Other teratological notes. Torreya **8**: 164–167. 29 Jl 1908. [Illust.]

Peck, C. H. Report of the state botanist, 1907. N. Y. State Mus. Bull. **122**: 5–175. *pl. 110–114.* 15 Au 1908.

Besides three chapters on *Crataegus* by C. S. Sargent, here indexed separately, the report includes also one new species of *Crataegus* and 8 new fungi, all by C. H. Peck.

Pilger, R. *Gramineae* andinae—IV. Bot. Jahrb. **42**: 60–72. 28 Jl 1908.

12 new species of *Calamagrostis* and several new varieties described.

Sampson, M. M. Some plants of Tiverton, Rhode Island. Rhodora **10**: 112, 113. 15 Jl 1908.

Sargent, C. S. Some additions to the *Crataegus* flora of western New York. N. Y. State Mus. Bull. **122**: 26–83. 15 Au 1908.

44 new species described.

Sargent, C. S. Notes on a collection of *Crataegus* made by Mr. G. D. Cornell in the neighborhood of Cooper's Plains, Steuben County, New York. N. Y. State Mus. Bull. **122**: 84–114. 15 Au 1908.

25 new species described.

Sargent, C. S. New York species of *Crataegus* from various localities. N. Y. State Mus. Bull. **122**: 115–130. 15 Au 1908.

14 new species described.

Schneider, C. K. *Berberides* andinae. Bot. Jahrb. **42**: 81–85. 28 Jl 1908.

3 species and several varieties described as new.

Schneider, C. K. *Hesperomelides* peruvianae. Bot. Jahrb. **42**: 85–88. 28 Jl 1908.

2 new species described.

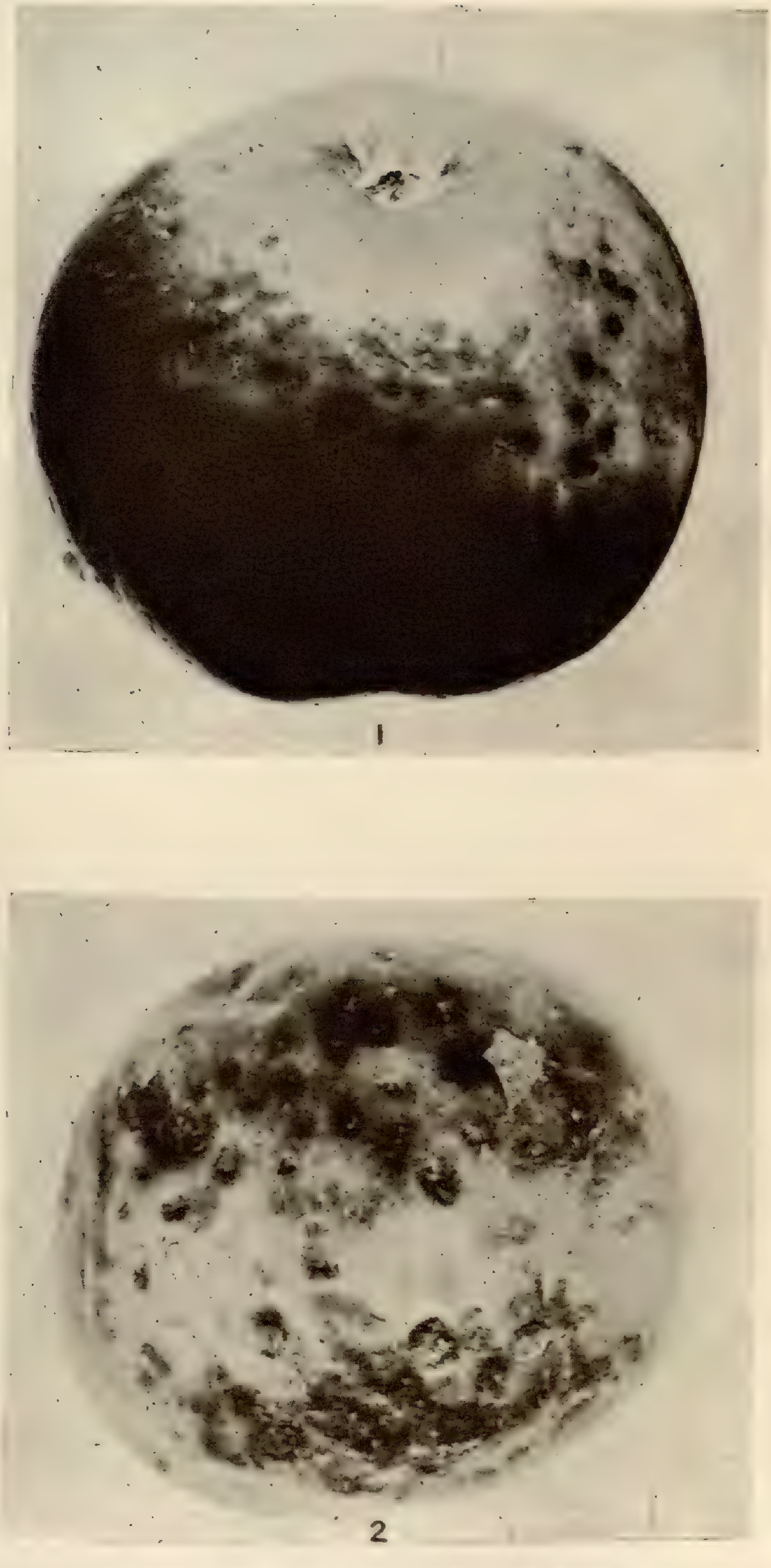
Schreiner, O., & Reed, H. S. The power of sodium nitrate and calcium carbonate to decrease toxicity in conjunction with plants growing in solution cultures. Jour. Am. Chem. Soc. **30**: 85–97. *f. 1, 2.* Ja 1908.

Setchell, W. A., & Collins, F. S. Some algae from Hudson Bay. Rhodora **10**: 114–116. 15 Jl 1908.

Shull, G. H. A new Mendelian ratio and several types of latency. Am. Nat. **42**: 433–451. [Au] 1908.

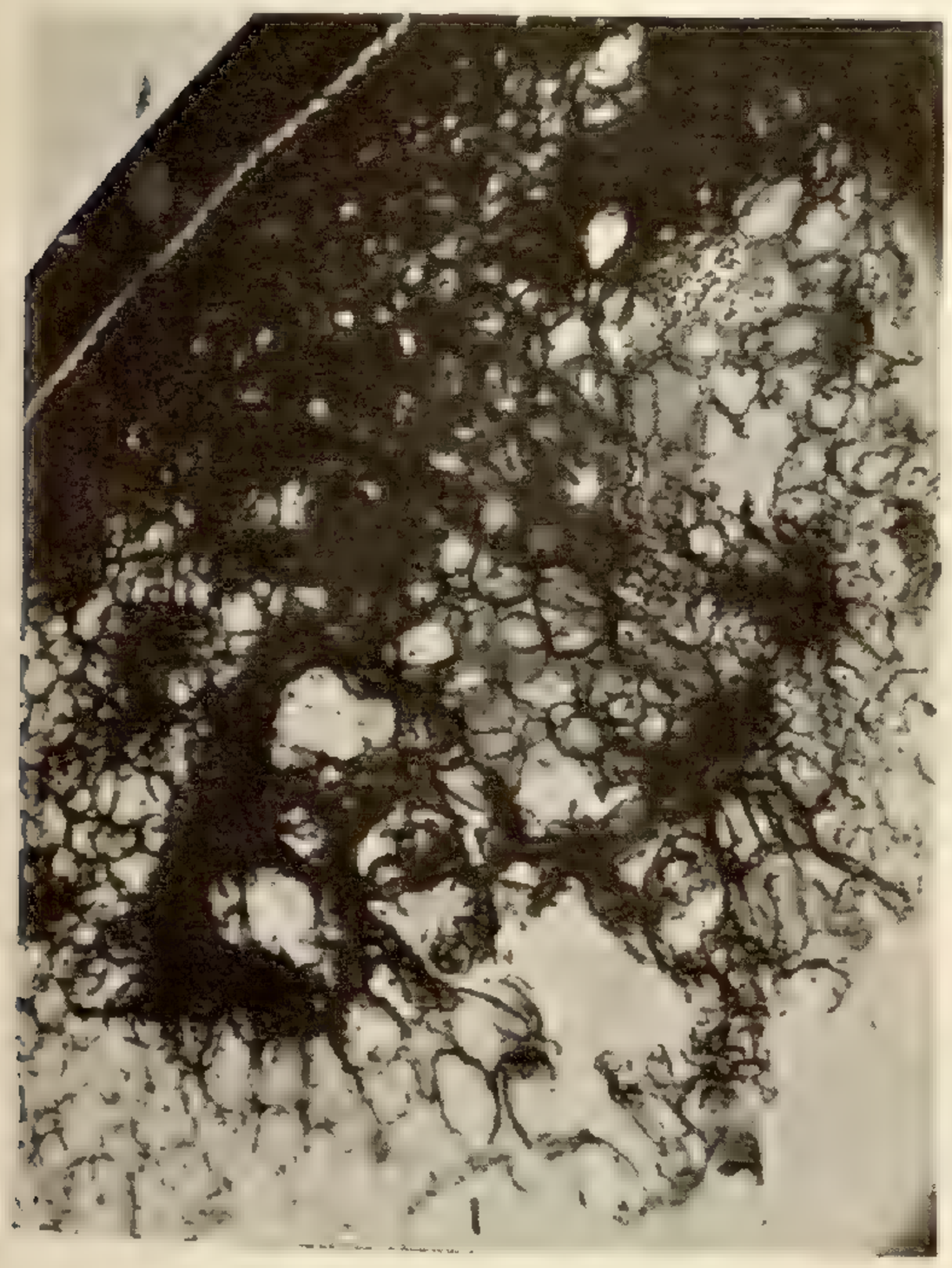
Sprague, T. A. *Bignoniaceae* peruvianae. Bot. Jahrb. **42**: 175–176. 28 Jl 1908.

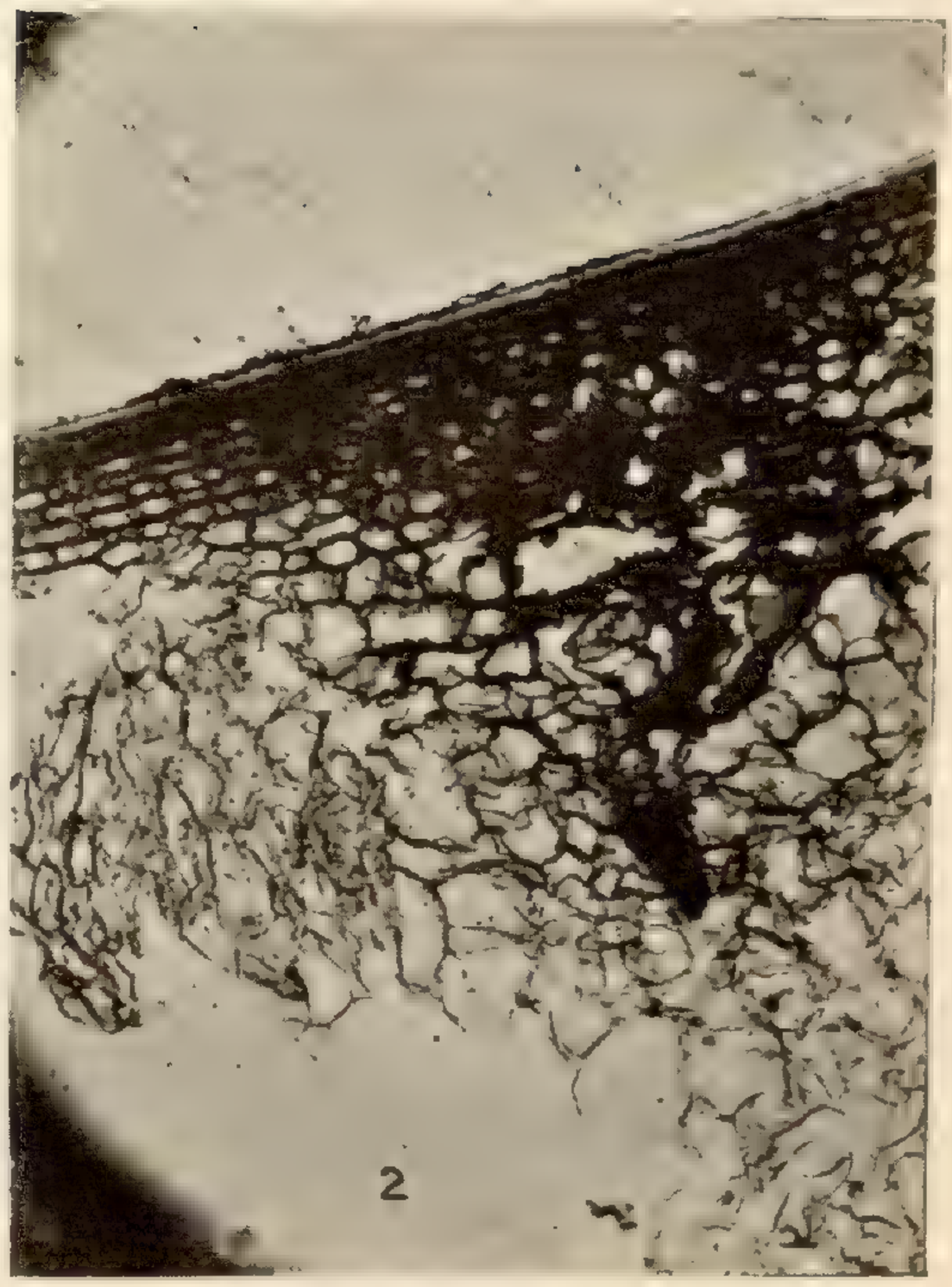
Arrabidaea Weberbaueri and *Tynnanthus Weberbaueri* spp. nov.

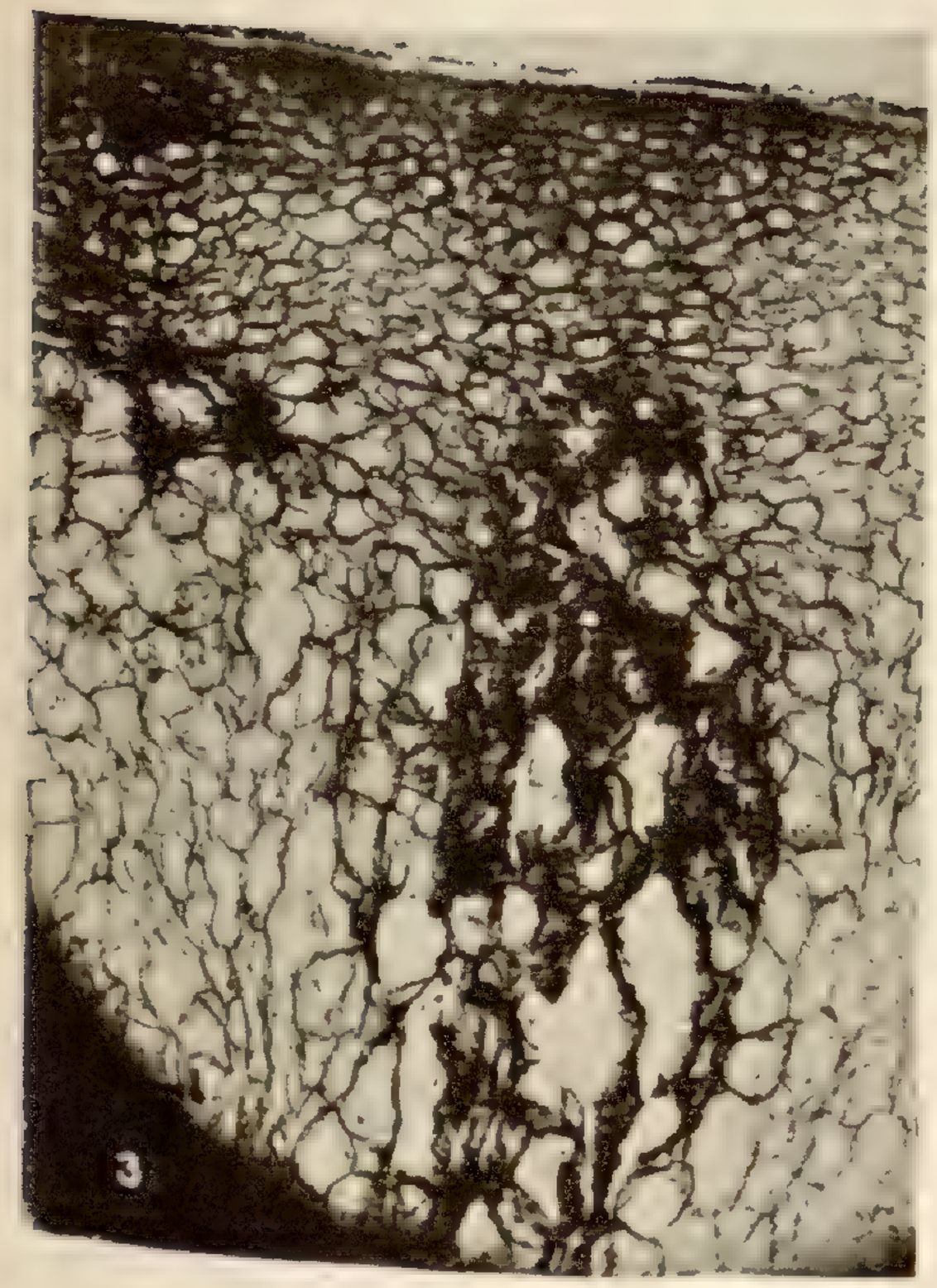


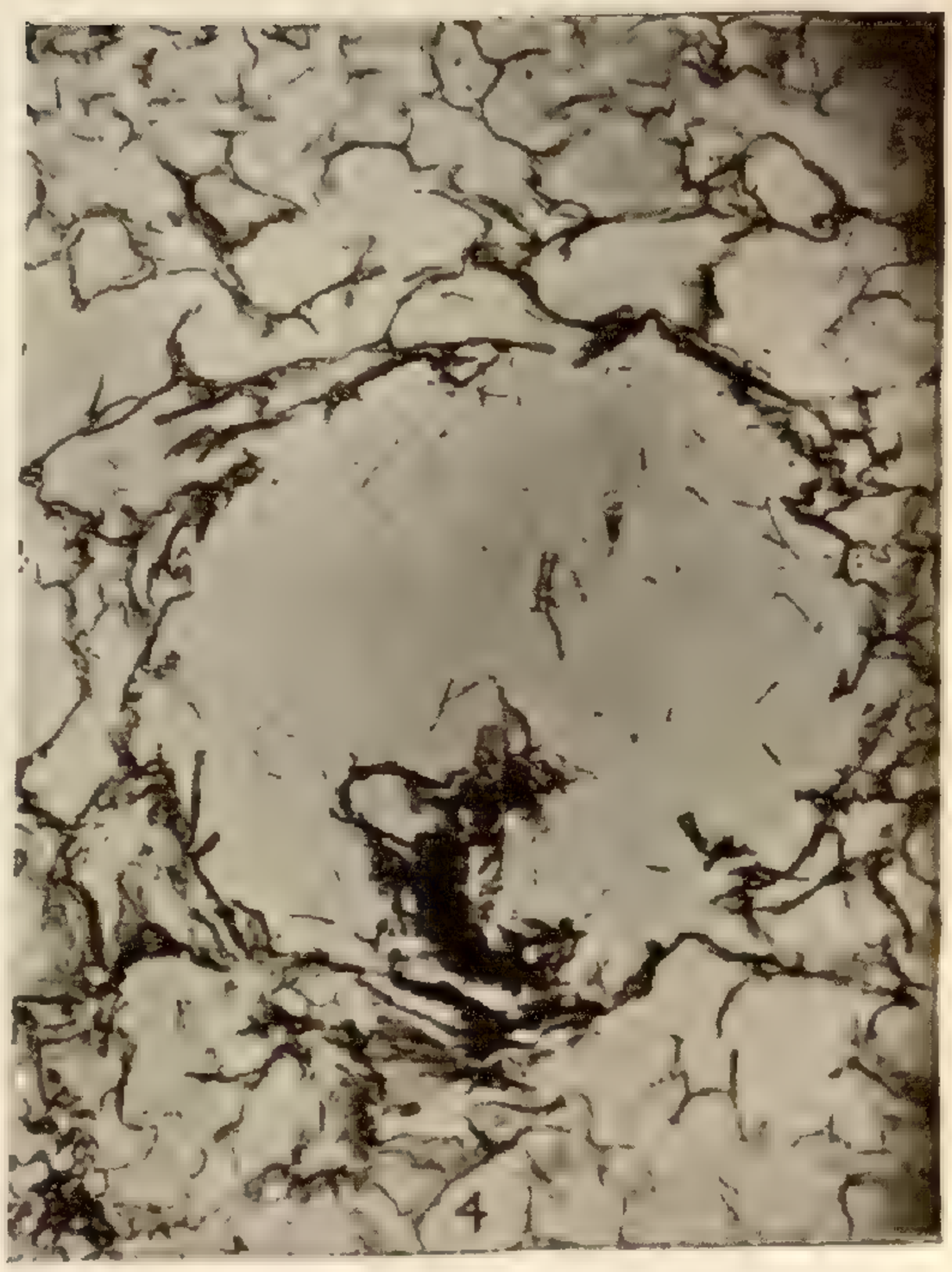
2

BROOKS, THE FRUIT SPOT OF APPLES





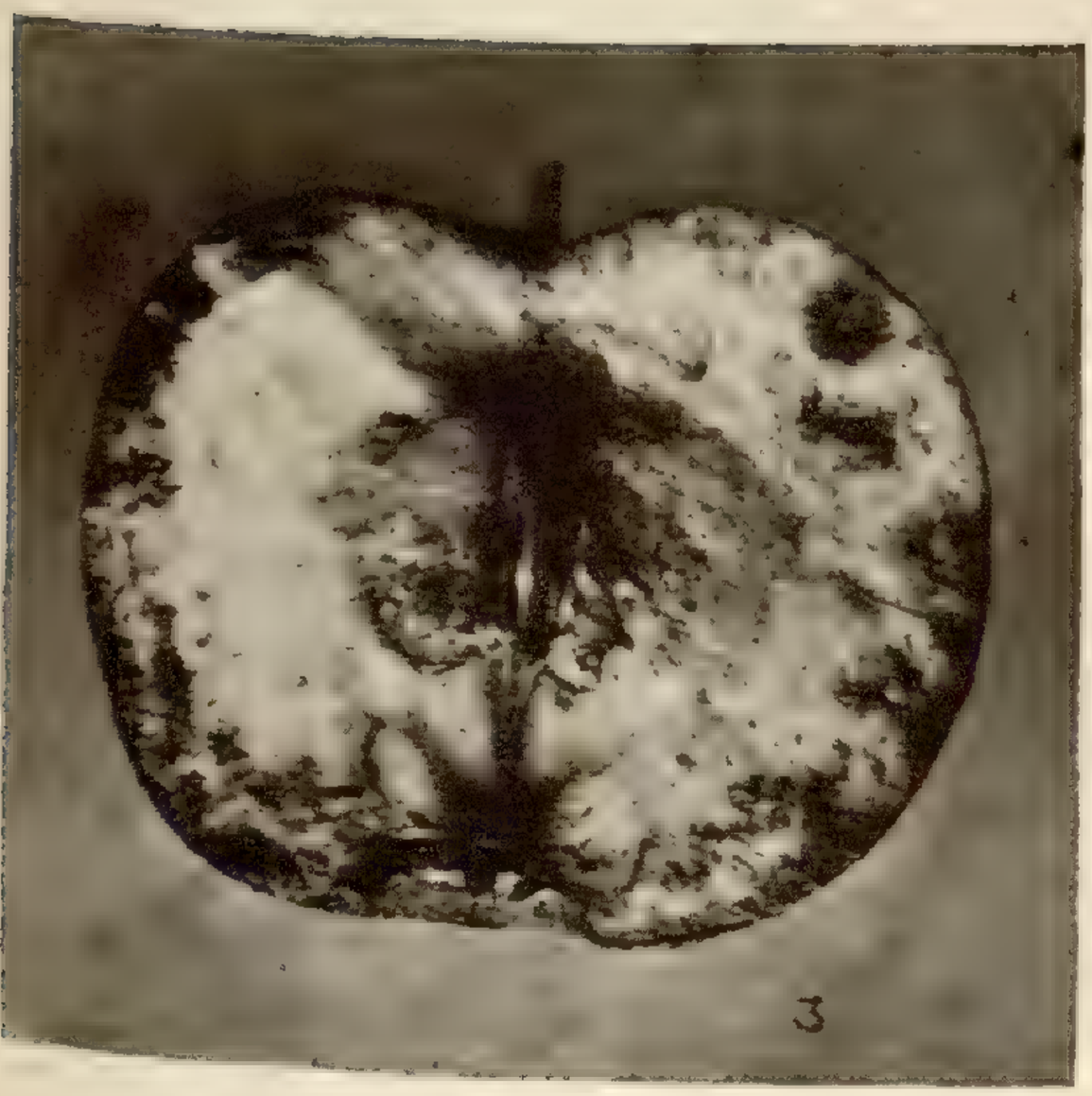


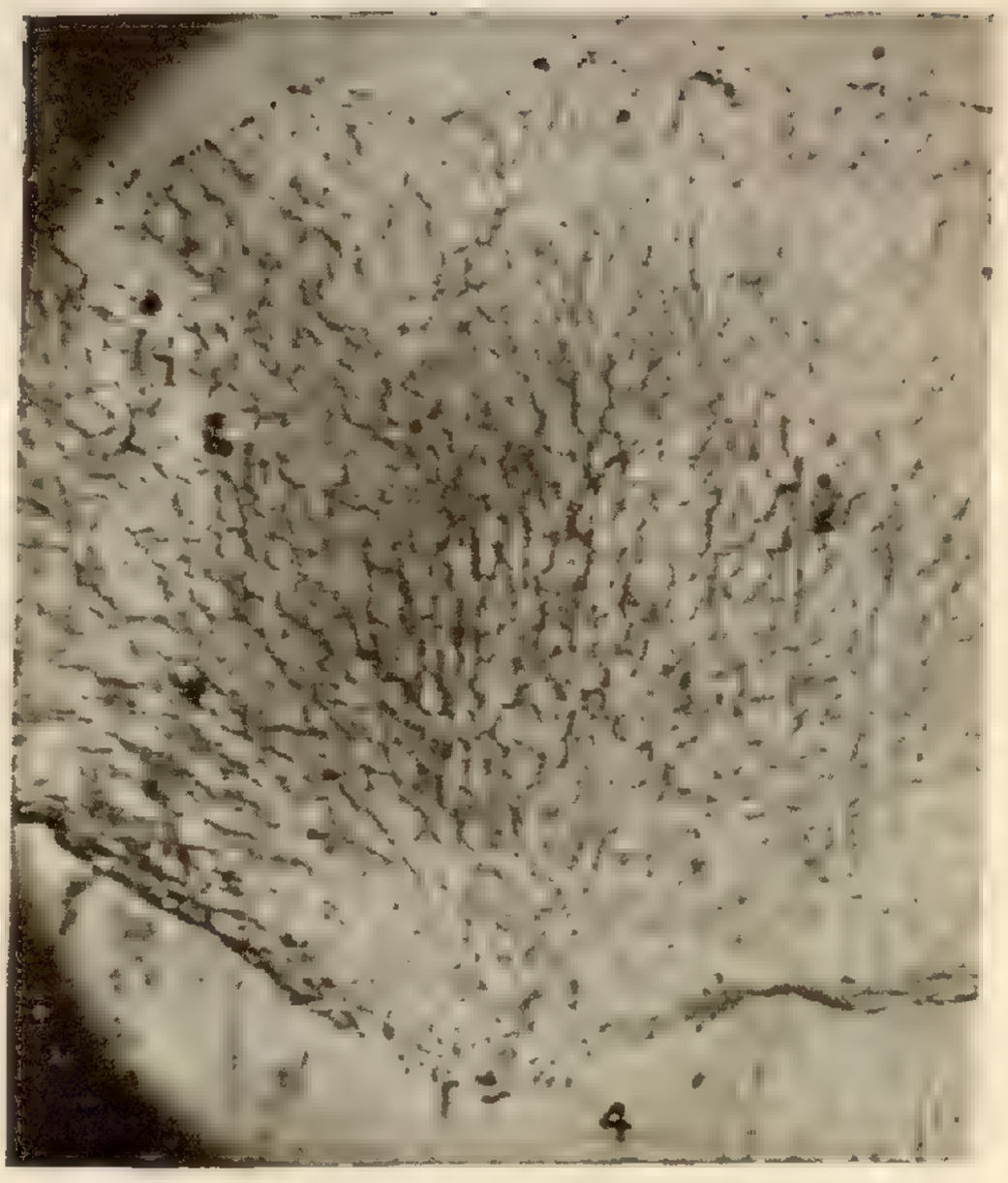


BROOKS, THE FRUIT SPOT OF APPLES

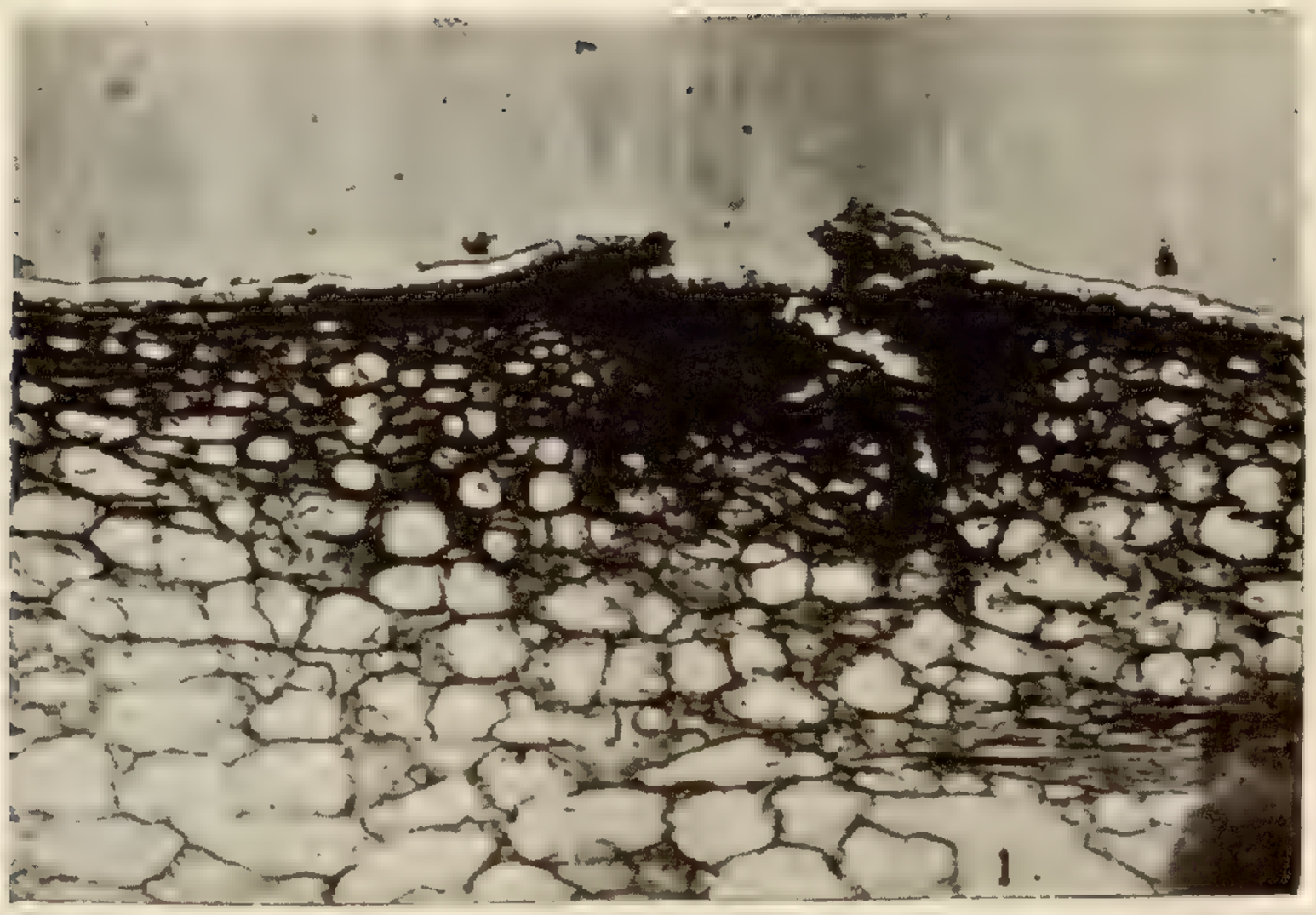
1

2

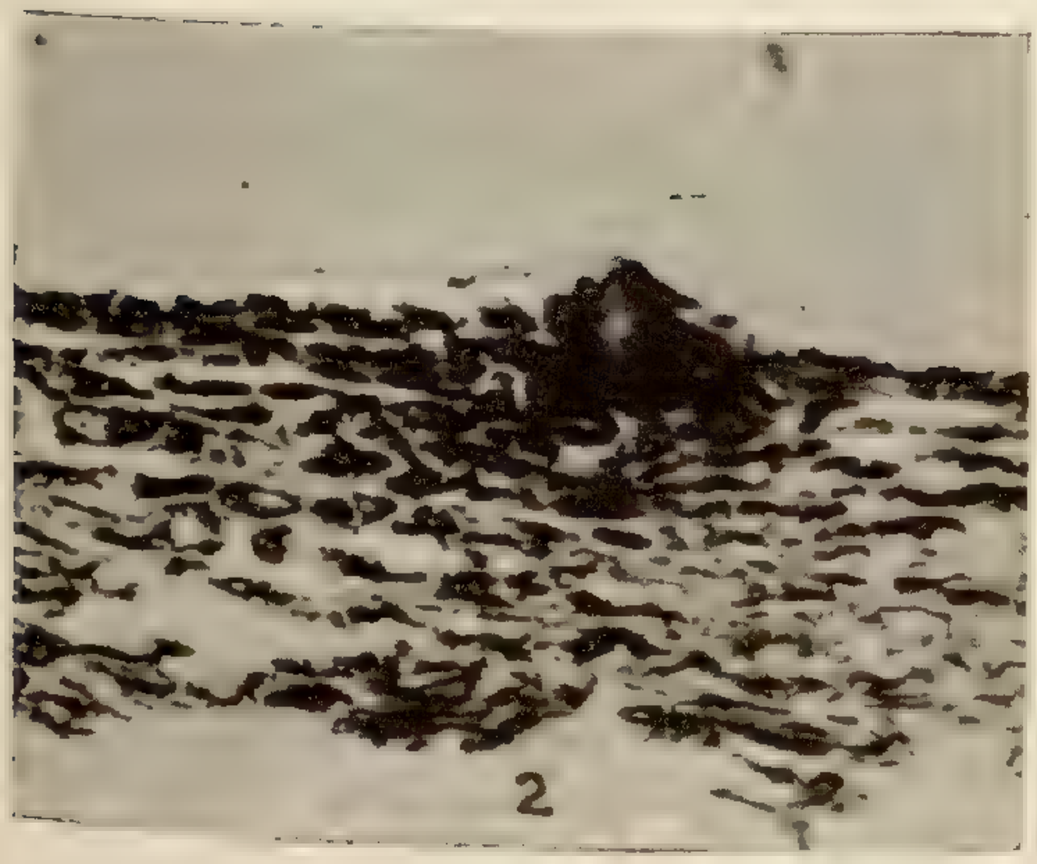

3


4

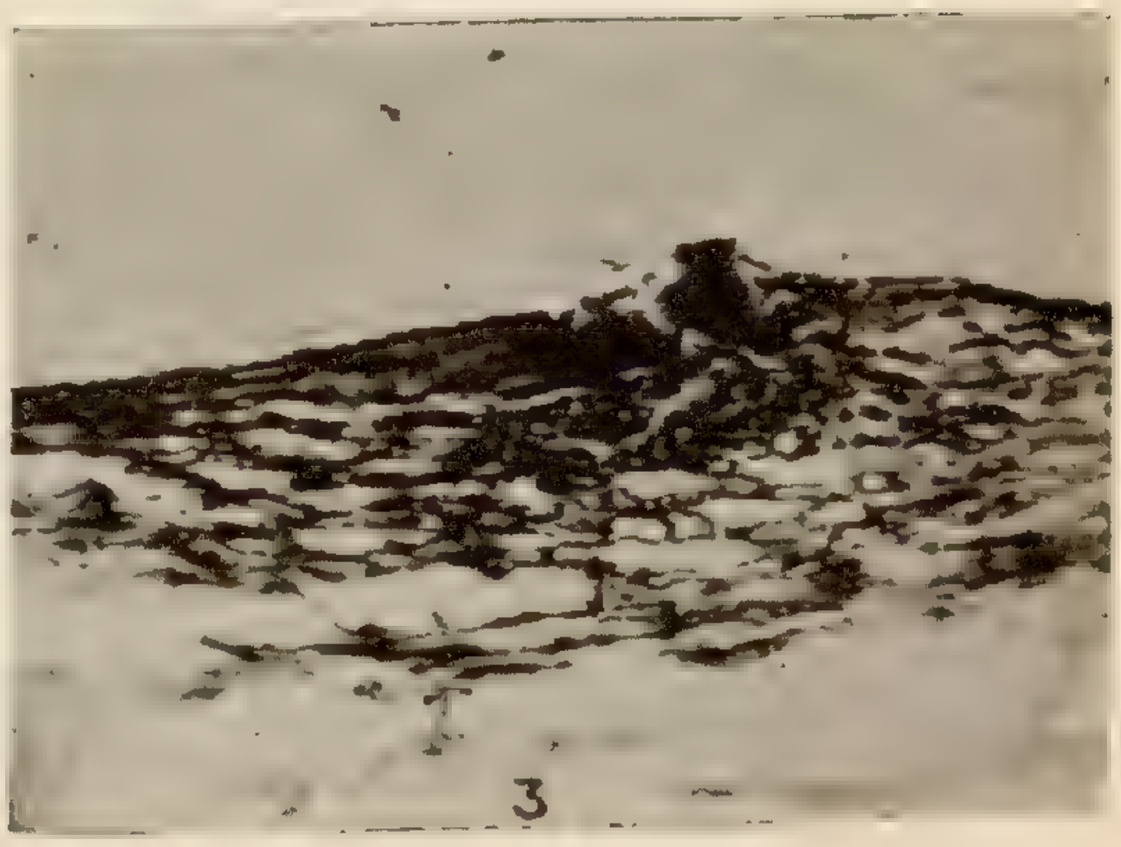
BROOKS, THE FRUIT SPOT OF APPLES



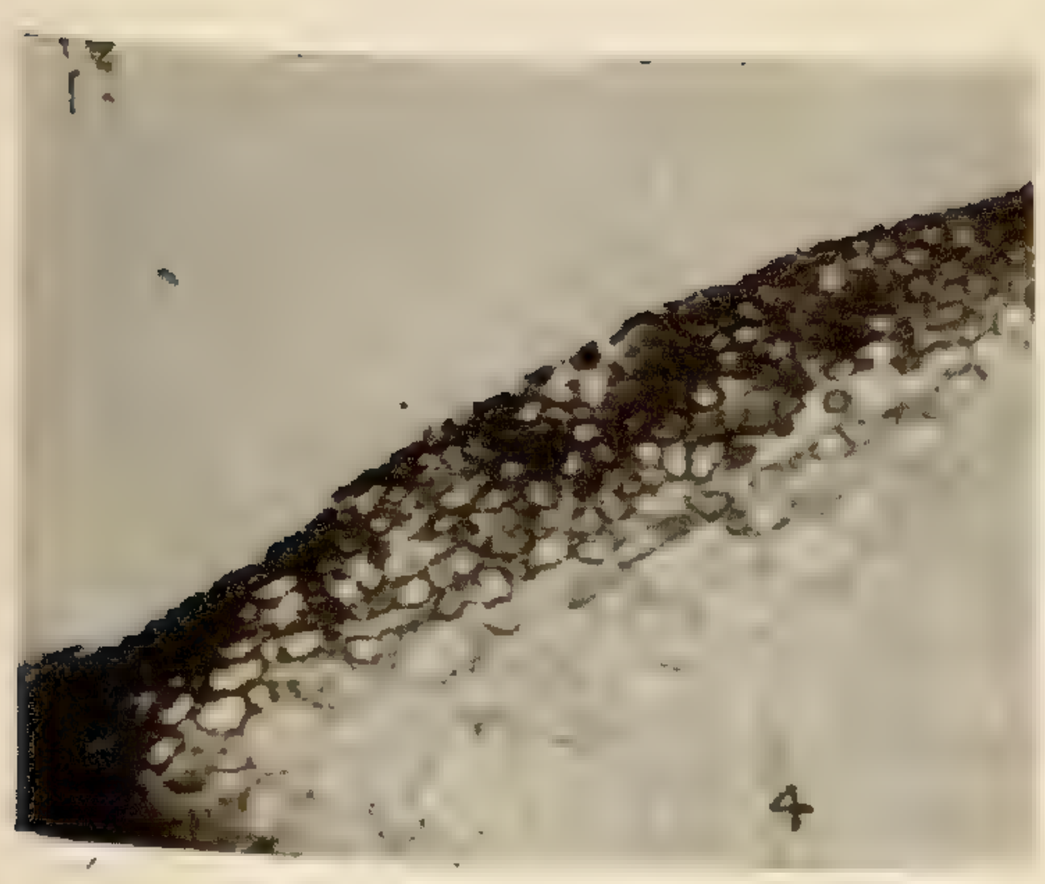
1.



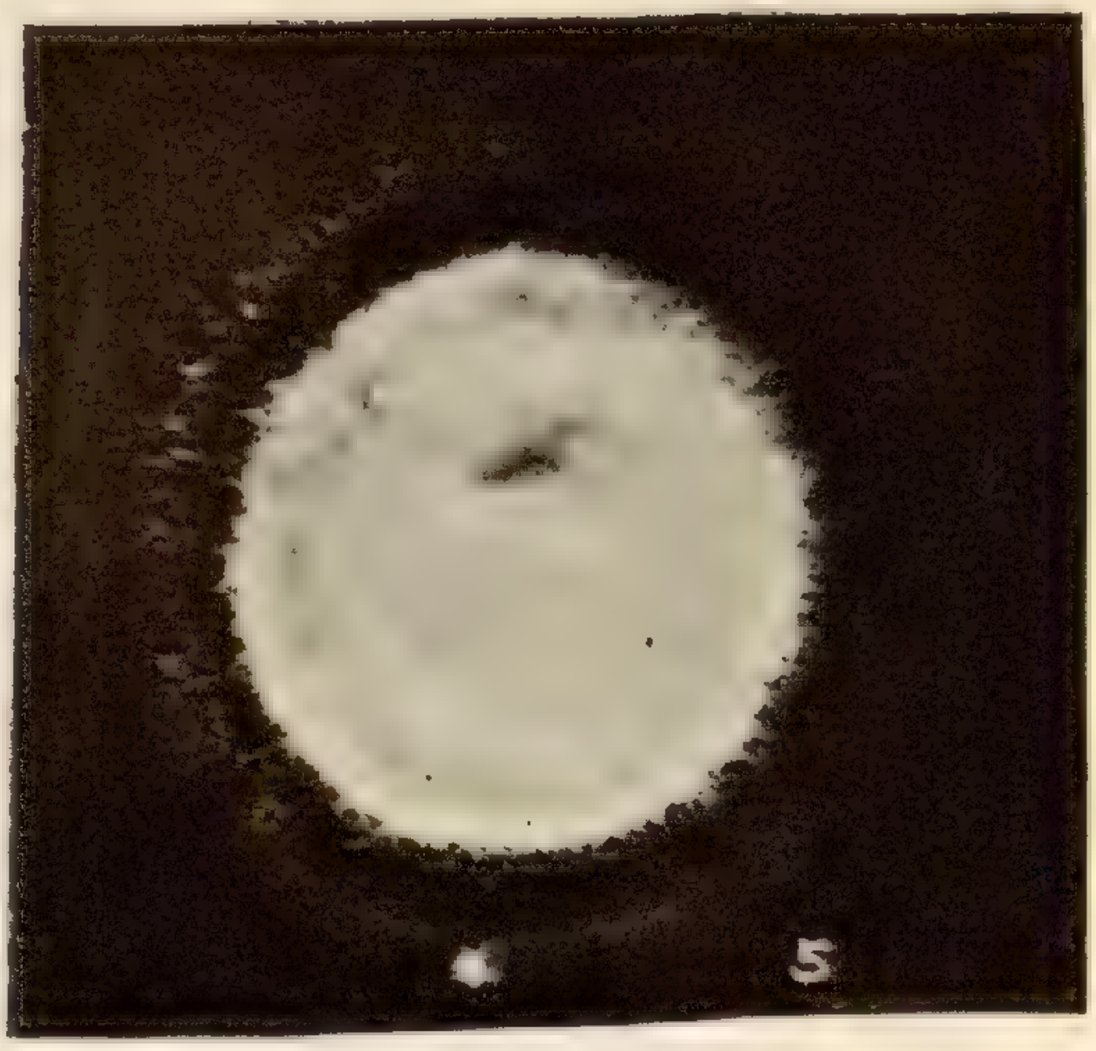
2



3

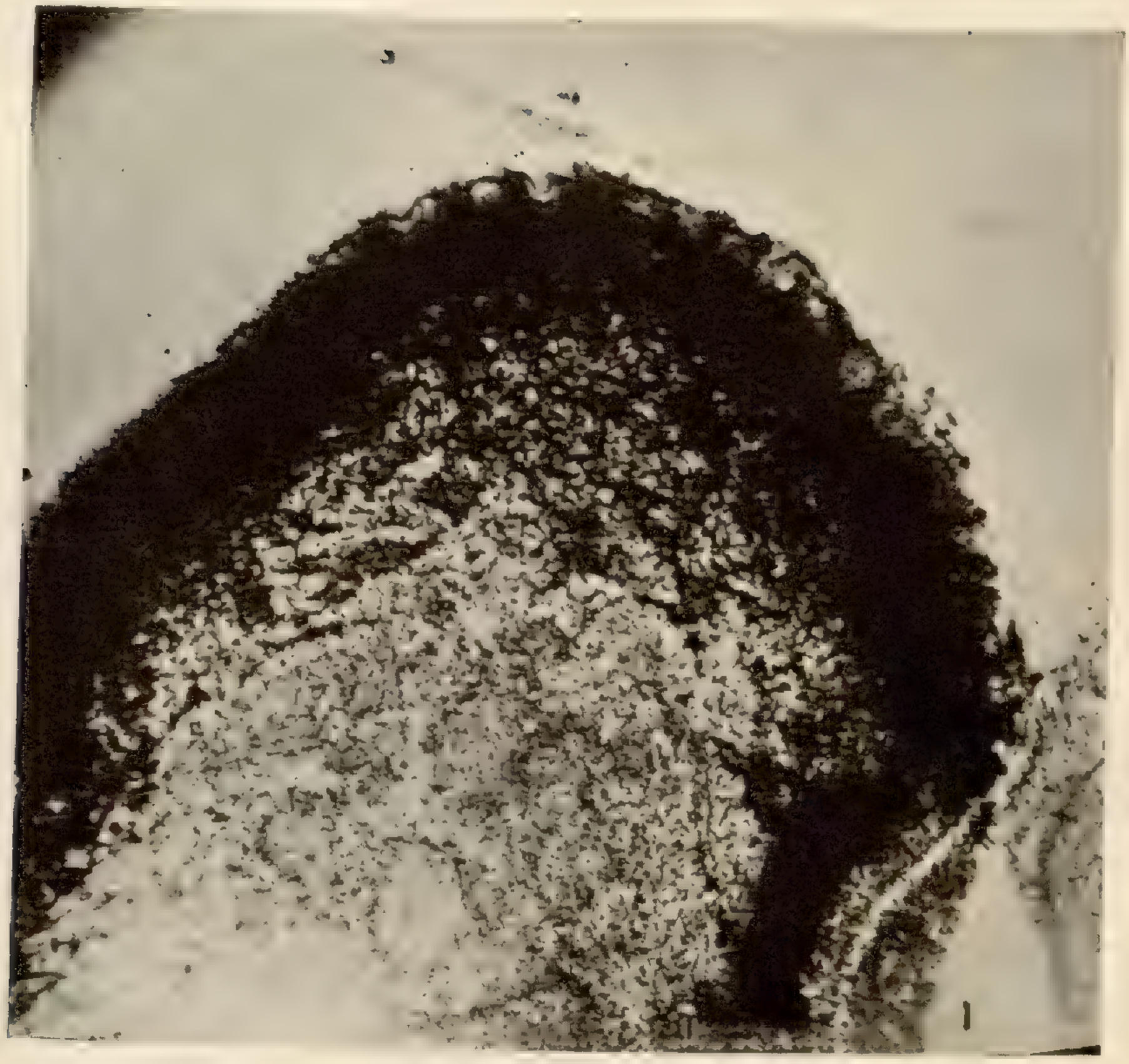


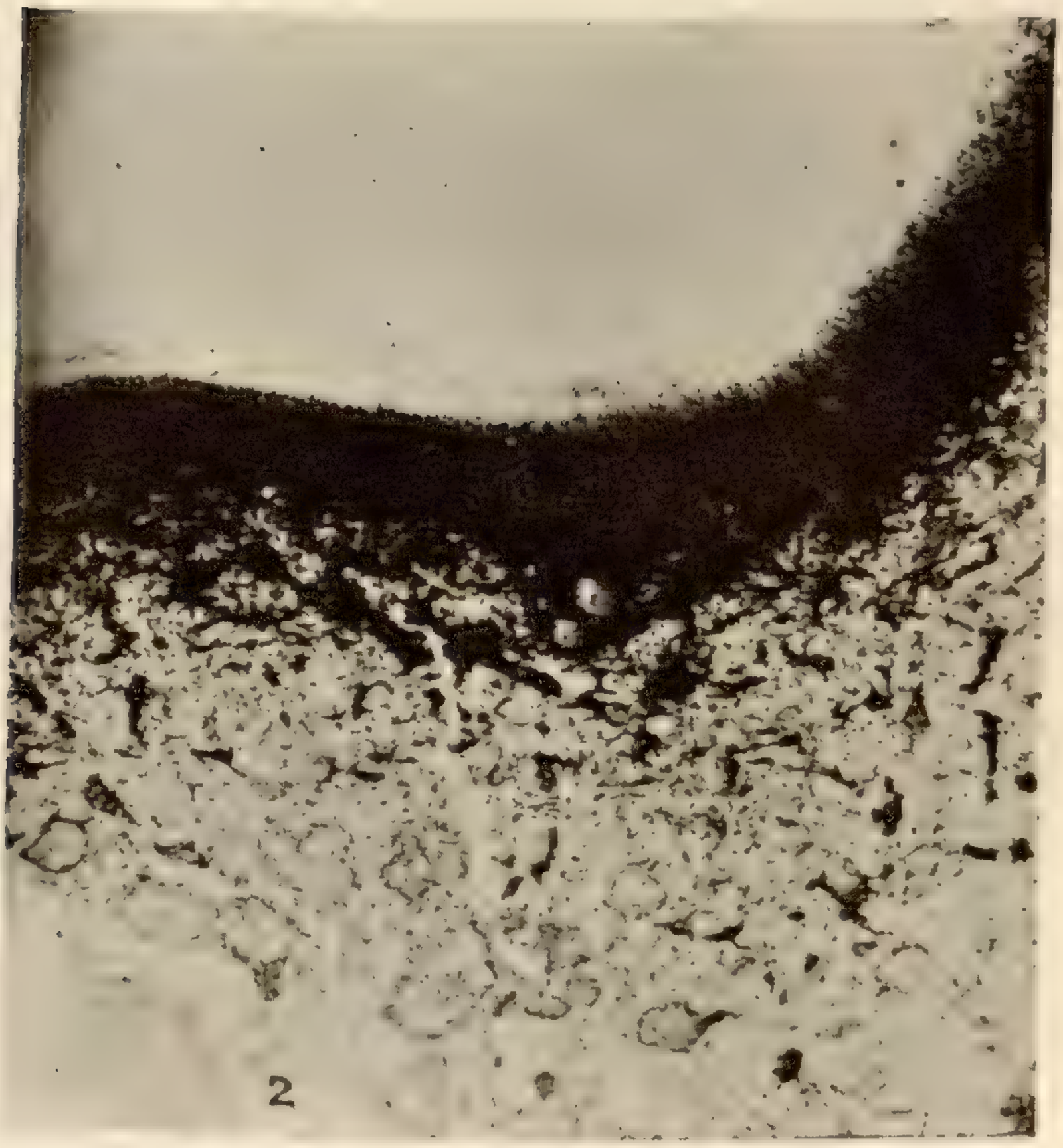
4



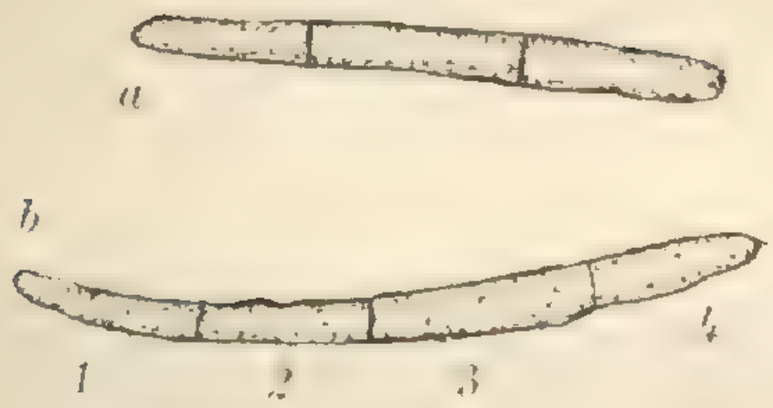
5

BROOKS, THE FRUIT SPOT OF APPLES

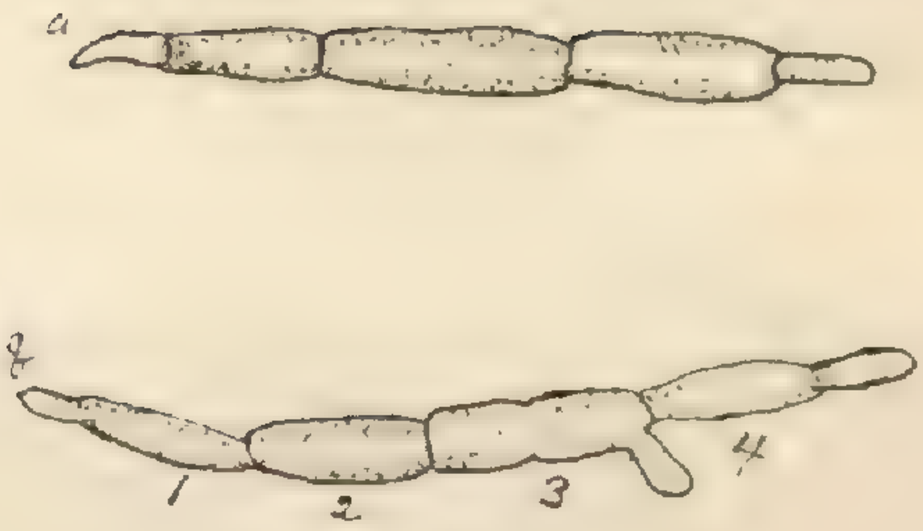




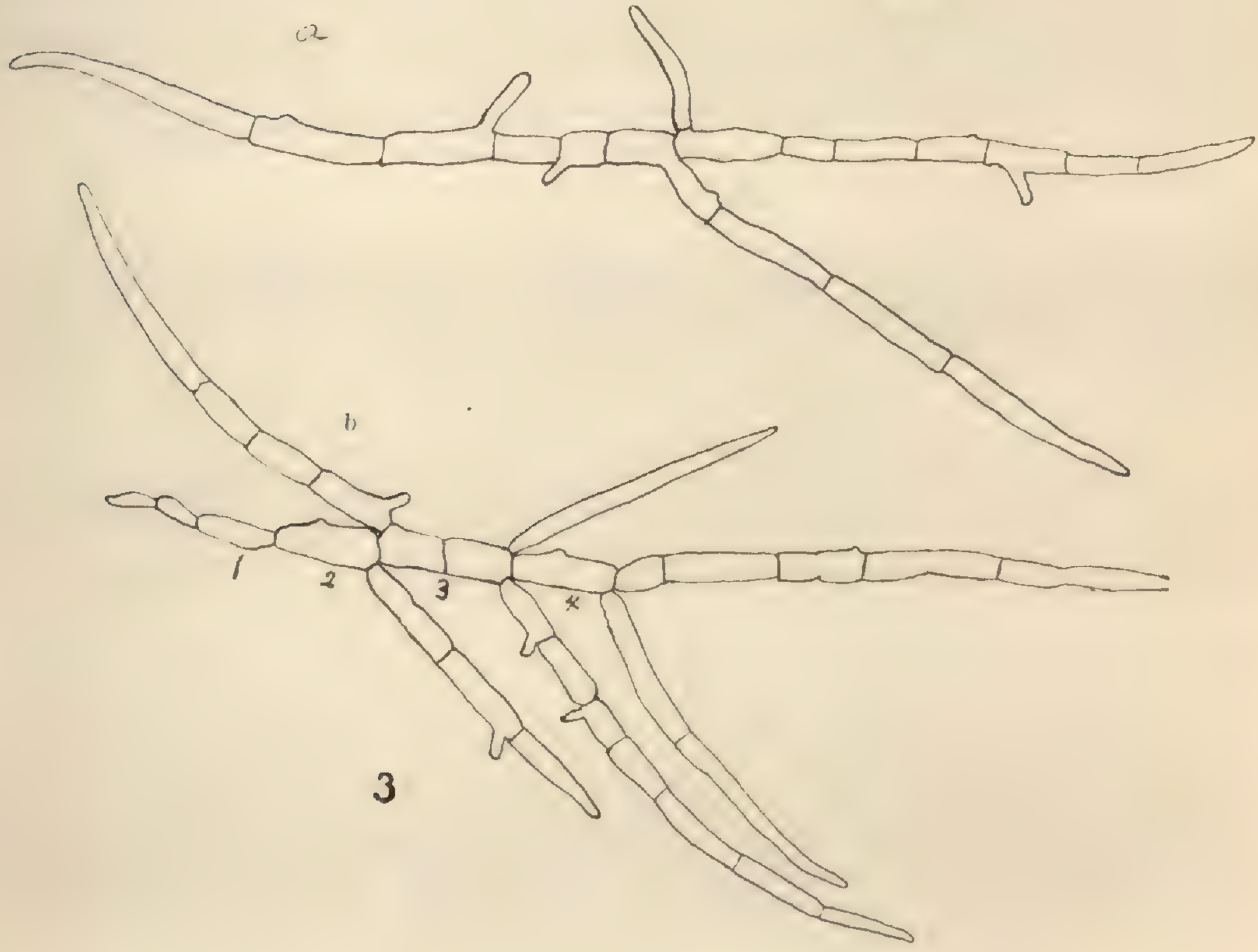
BROOKS, THE FRUIT SPOT OF APPLES



1



2

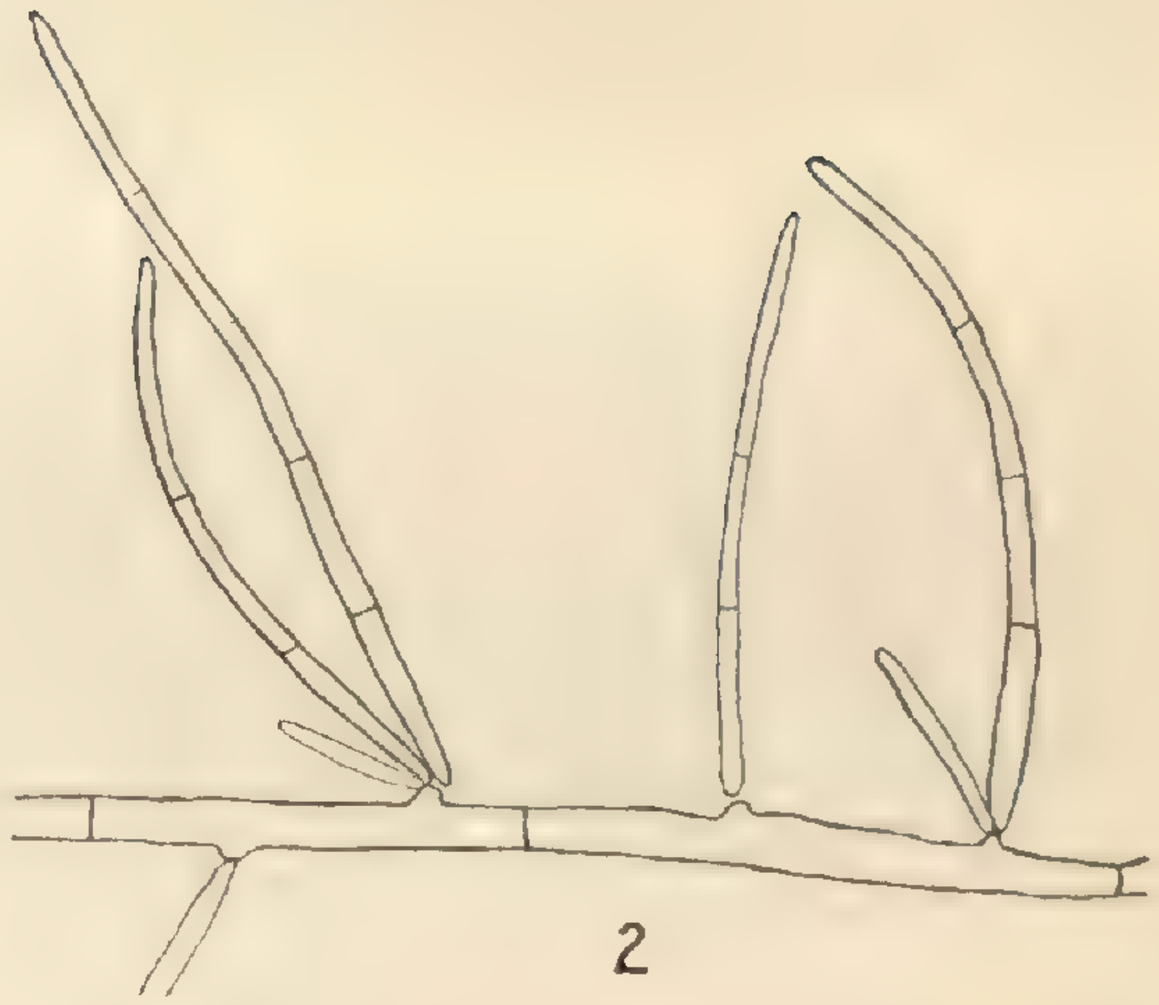


3

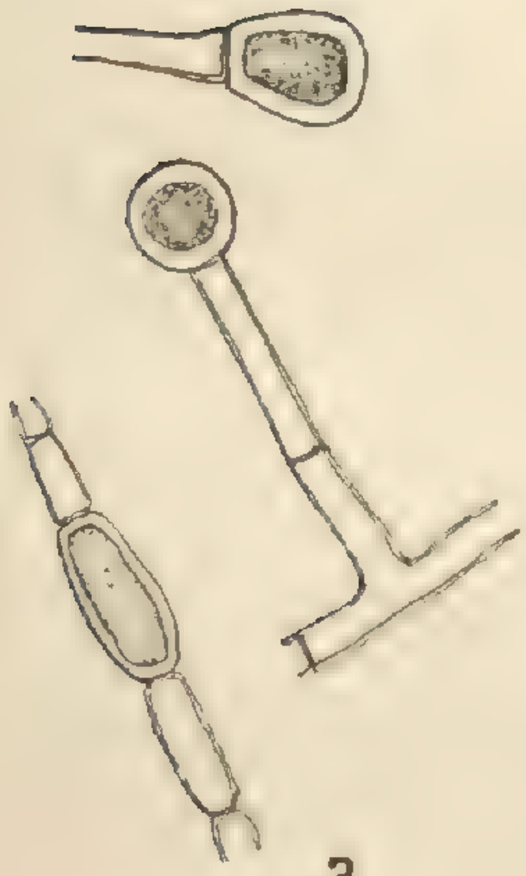
4

BROOKS, THE FRUIT SPOT OF APPLES

1

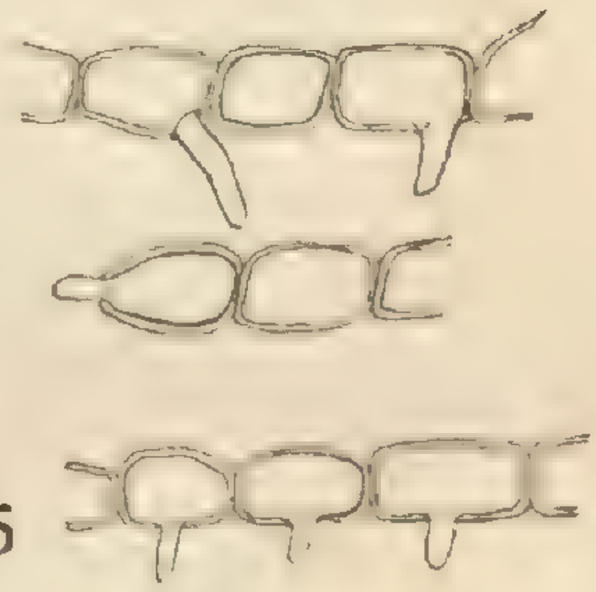


2

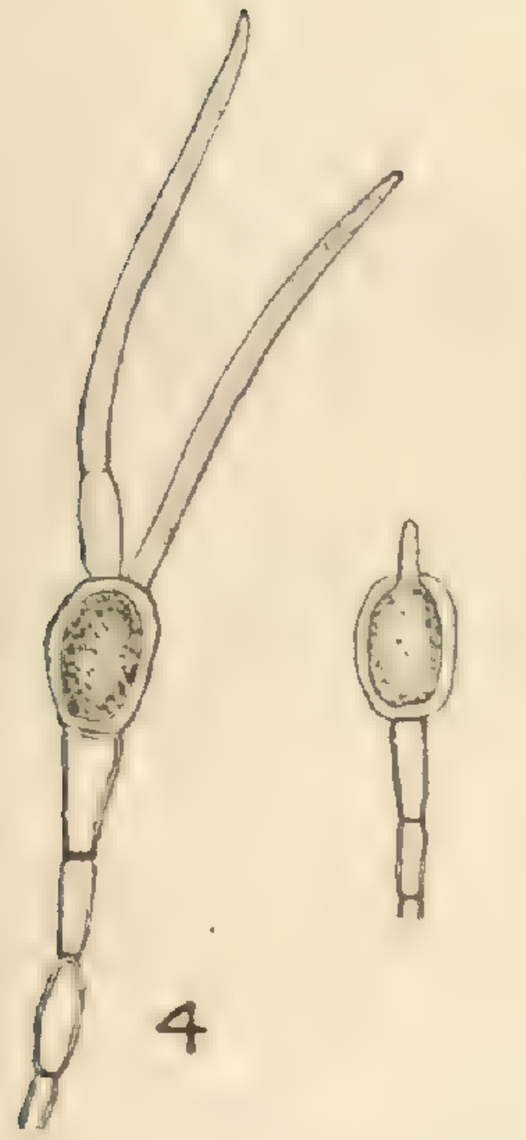


3

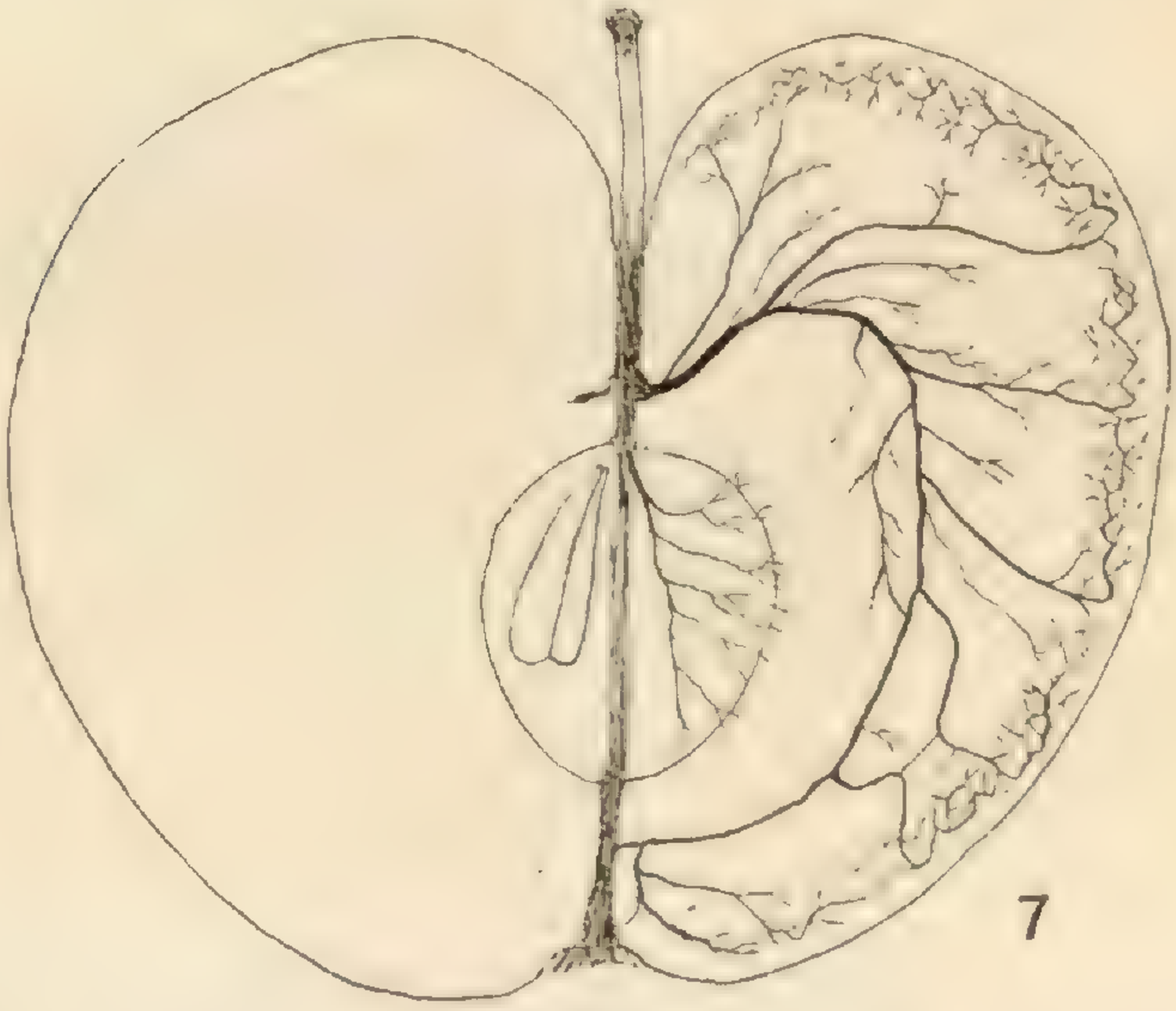
6



5



4



7

BROOKS, THE FRUIT SPOT OF APPLES

THE BRYOLOGIST

WITH THE JANUARY, 1908, NUMBER BEGINS ITS

ELEVENTH YEAR AND VOLUME

It is a 16-20 page bi-monthly devoted to the study of the Mosses, Hepatics, and Lichens. It is fully illustrated with new, original, and artistic drawings and half-tones. It is indispensable to the working bryologist, professional as well as amateur. Send for sample copy. Subscription price $1.00 a year.

Address, MRS. ANNIE MORRILL SMITH, 78 Orange Street, Brooklyn, N. Y.

INDEX TO

AMERICAN BOTANICAL LITERATURE

This Index, printed each month in the BULLETIN, is reissued on library catalogue cards; these are furnished to subscribers at the rate of one cent for each card.

Subscriptions to the card-issue may be addressed to the Treasurer of the Torrey Botanical Club,

WILLIAM MANSFIELD, COLLEGE OF PHARMACY, 115 W. 68th St., N. Y. City.

Beginning with January, 1903, the Index has also been reprinted on paper, on one side only, and can be furnished in that form at the rate of $3.00 a year.

North American Flora

THIS work is designed to present descriptions of all plants growing independently of cultivation, in North America, here taken to include Greenland, Central America, the Republic of Panama, and the West Indies, except Trinidad, Tobago, and Curaçao and other islands off the north coast of Venezula, whose flora is essentially South American.

It will be published in parts at irregular intervals by the New York Botanical Garden through the aid of the income of the David Lydig Fund bequeathed by Charles P. Daly.

It is planned to issue parts as rapidly as they can be prepared, the extent of the work making it possible to commence publication at any number of points. The completed work will form a series of volumes with the following sequence:

Volume 1. Mycetozoa, Schizophyta, Diatomaceae.
Volume 2 to 10. Fungi.
Volumes 11 to 13. Algae.
Volumes 14 and 15. Bryophyta.
Volume 16. Pteridophyta and Gymnospermae.
Volumes 17 to 19. Monocotyledones.
Volumes 20 to 30. Dicotyledones.

The preparation of the work has been referred by the Scientific Directors of the Garden to a committee consisting of Dr. N. L. Britton, Dr. W. A. Murrill and Dr. J. H. Barnhart.

Professor George F. Atkinson, of Cornell University, Professors Charles R. Barnes and John M. Coulter, of the University of Chicago, Mr. Frederick V. Coville, of the United States Department of Agriculture, Professor Edward L. Greene, of the United States National Museum, Professor Byron D. Halsted, of Rutgers College, and Professor William Trelease, of the Missouri Botanical Garden, have consented to act as an advisory committee.

Vol. 7, Part 1, Ustilaginales, including Ustilaginaceae and Tilletiaceae, by G. P. Clinton, was issued Oct. 4, 1906. Vol. 7, Part 2, Coleosporiaceae, Uredinaceae, and Aecidiaceae (pars), of the Uredinales, by J. C. Arthur, was issued March 6, 1907. Vol. 9, Parts 1 and 2, Polyporaceae, by W. A. Murrill, were issued Dec. 19, 1907, and March 12, 1908. Vol. 22, Part 1, including Podostemonaceae by George V. Nash, Crassulaceae by N. L. Britton and J. N. Rose, and Penthoraceae and Parnassiaceae by P. A. Rydberg, was issued May 22, 1905. Vol. 22, Part 2, including Saxifragaceae and Hydrangeaceae by J. K. Small and P. A. Rydberg, Cunoniaceae, Iteaceae, and Hamamelidaceae by N. L. Britton, Pterostemonaceae by J. K. Small, Altingiaceae by Percy Wilson, and Phyllonomaceae by H. H. Rusby, was issued Dec. 18, 1905. Vol. 22, Part 3, Grossulariaceae by F. V. Coville and N. L. Britton, Platanaceae by H. A. Gleason, Crossosomataceae by J. K. Small, Connaraceae by N. L. Britton, Calycanthaceae by C. L. Pollard, and Rosaceae (pars) by P. A. Rydberg, was issued June 12, 1908. Vol. 25, Part 1, including Geraniaceae by L. T. Hanks and J. K. Small, Oxalidaceae and Linaceae by J. K. Small, and Erythroxylaceae by N. L. Britton, was issued Aug. 24, 1907.

The subscription price is fixed at $1.50 for each part; it is expected that four or five parts will be required for each volume. A limited number of separate parts will be sold at $2.00 each. Address

THE NEW YORK BOTANICAL GARDEN
BRONX PARK, NEW YORK CITY.

PUBLICATIONS BY OFFICERS AND STUDENTS OF THE DEPARTMENT OF BOTANY, COLUMBIA UNIVERSITY

1. MEMOIRS OF THE DEPARTMENT:

Vol. 1. A Monograph of the North American Species of the Genus *Polygonum* (1895). By John Kunkel Small, Fellow in Botany, 1893–1895; Curator of the Herbarium, 1895–1898.

Quarto, 178 pages, 84 plates. Price $6.00.

Vol. 2. A Monograph of the North American Potentilleae (1898). By Per Axel Rydberg, Fellow in Botany, 1896–7.

Quarto, 224 pages, 112 plates. Price $6.00.

2. CONTRIBUTIONS FROM THE DEPARTMENT:

Vol. 1. Nos. 1–25. 1886–1892. Price $5.00.
Vol. 2. Nos. 26–50. 1892–1894. Price $5.00.
Vol. 3. Nos. 51–75. 1894–1895. Price $5.00.
Vol. 4. Nos. 76–100. 1895–1896. Price $5.00.
Vol. 5. Nos. 101–125. 1896–1897. Price $5.00.
Vol. 6. Nos. 126–150. 1897–1898. Price $5.00.
Vol. 7. Nos. 151–175. 1898–1901. Price $5.00.
Vol. 8. Nos. 176–200. 1901–1902. Price $5.00.
Vol. 9. Nos. 201–. 1903–(current).

List of separate numbers available on application.

3. A Text-book of General Lichenology (1896). By Albert Schneider, Fellow in Botany, 1895–1896.

Octavo, 230 pages, 76 plates. Price $4.25 (cloth); $3.80 (paper). Published by Willard N. Clute & Co. Binghamton, N. Y.

The Department invites propositions relative to exchanges of herbarium material for any of the above named publications. Address Dr. Carlton C. Curtis, Columbia University, N. Y. City.

4. An Illustrated Flora of the Northern United States, Canada, and the British Possessions from Newfoundland to the Parallel of the Southern Boundary of Virginia, and from the Atlantic Ocean westward to the 102d Meridian (1896–1898). By Nathaniel Lord Britton, Professor of Botany, 1891–1896; Emeritus Professor 1896–, and Hon. Addison Brown.

Three volumes, royal octavo. Vol. 1, 612 pages; Vol. 2, 642 pages; Vol. 3, 588 pages; 4162 figures in the text, illustrating every species described.

Published by Charles Scribner's Sons, New York. Price, in cloth, $9.00 for the three volumes; with the indexes and keys bound separately, $10.00.

5. Our Native Ferns and their Allies. (Sixth Edition) 1900. By Lucien Marcus Underwood, Professor of Botany, 1896–1907.

Duodecimo, 158 pages, 35 figures. Published by Henry Holt & Co., New York. Price, $1.00.

6. Moulds, Mildews, and Mushrooms. By Lucien Marcus Underwood, Professor of Botany, 1896–1907.

Duodecimo, 236 pages, 10 plates. Published by Henry Holt & Co. Price $1.50.

7. Nature and Development of Plants (1907). By Carlton Clarence Curtis, Assistant in Botany, 1892–1895; Tutor in Botany, 1895–1906; Instructor in Botany, 1906–.

Octavo, 471 pages; 342 illustrations. Published by Henry Holt & Co., New York. Price $2.50.

ESTABLISHED 1851

EIMER & AMEND

205–211 Third Ave.,
Corner 18th Street

NEW YORK

MANUFACTURERS AND IMPORTERS OF

Chemicals and Chemical Apparatus

Our Specialties

MICROSCOPES
and
ACCESSORIES

MICROTOMES

BALANCES
and
WEIGHTS

Sole Agents for

C. A. F.
KAHLBAUM'S
C. P. Chemicals
and Reagents

CARL
SCHLEICHER
& SCHÜLL'S
C. P. Filters

SCHOTT &
GENOSSEN'S
Famous Laboratory Glassware

And for many other renowned European houses in our line.

COMPLETE LINE OF

Bacteriological Apparatus

WE HANDLE

EVERYTHING NEEDED FOR A LABORATORY

Inspection of premises cordially invited.

MEMOIRS OF THE TORREY BOTANICAL CLUB

A series of technical papers on botanical subjects, published at irregular intervals. Price $3.00 a volume. Not offered in exchange.

Vol. 1, No. 1; not furnished separately:

Bailey, Liberty Hyde. Studies of the types of various species of the genus *Carex*. Pages 1–85. 25 My 1889.

Vol. 1, No. 2; not furnished separately:

Martindale, Isaac Comly. Marine algae of the New Jersey coast and adjacent waters of Staten Island. Pages 87–111. 24 Au 1889.

Vol. 1, No. 3; price, 75 cents:

Spruce, Richard. *Hepaticae* Bolivianae, in Andibus Boliviae orientalis, annis 1885–6, a cl. H. H. Rusby lectae. Pages 113–140. 20 Ja 1890.

Vol. 1, No. 4; price, 75 cents:

Sturtevant, Edward Lewis. On seedless fruits. Pages 141–187. 30 My 1890.

Vol. 2, No. 1; not furnished separately:

Halsted, Byron David. Reserve food-materials in buds and surrounding parts. Pages 1–26, *plates 1, 2*. 10 S 1890.

Vol. 2, No. 2; price, 75 cents:

Vail, Anna Murray, & Hollick, Charles Arthur. Contributions to the botany of Virginia. Pages 27–56, *plates 3, 4*. 23 D 1890.

Vol. 2, No. 3; not furnished separately:

Holm, Herman Theodor. Contributions to the knowledge of the germination of some North American plants. Pages 57–108, *plates 5–19*. 15 Ap 1891.

Vol. 2, No. 4; price, 75 cents:

Wheelock, William Efner. The genus *Polygala* in North America. Pages 109–152. 30 D 1891.

Vol. 3, No 1; not furnished separately:

Small, John Kunkel, & Heller, Amos Arthur. Flora of western North Carolina and contiguous territory. Pages 1–39. 20 F 1892.

Vol 3, No. 2; price, $2.00:

Morong, Thomas. The *Naiadaceae* of North America [with illustrations of all the species]. Pages 1–65, *plates 20–74*. 15 Mr 1893.

Vol. 3, No. 3; not furnished separately:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. [Part 1.] Pages 1–67. 28 Ap 1893.

Vol. 4, No. 1; not furnished separately:

Underwood, Lucien Marcus. Index *Hepaticarum*. Part I, Bibliography. Pages 1–91. 10 Je 1893.

Vol. 4, No. 2; not furnished separately:

Small, John Kunkel, & Vail, Anna Murray. Report on the botanical exploration of southwestern Virginia during the season of 1892. Pages 93–201, *plates 75–82*. 18 N 1893–17 Ap 1894.

Vol. 4, No. 3; price, 50 cents:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 2. Pages 203–274. 10 Mr–17 Ap 1895.

Vol. 4, No. 4; price, 50 cents:

Pettit, Anna Stockton. *Arachis hypogaea* L. Pages 275–296, *plates 83–85* 5 Je 1895.

Vol. 4, No. 5; price, 75 cents:

Rydberg, Per Axel. The North American species of *Physalis* and related genera. Pages 297–374. 15 S 1896.

Vol. 5; price, $3.00:

List of *Pteridophyta* and *Spermatophyta* growing without cultivation in northeastern North America. Pages 1–377. 4 D 1893–31 D 1894.

Vol. 6, No. 1; price, $1.25:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 3. Pages 1–130. 17 N 1896.

Vol. 6, No. 2; not furnished separately:

Grout, Abel Joel. A revision of the North American *Isotheciaceae* and *Brachytheciaceae*. Pages 131–210. 30 Jl 1897.

Vol. 6, No. 3; price, 50 cents:

Hazen, Tracy Elliot. The life history of *Sphaerella lacustris* (*Haematococcus pluvialis*). Pages 211–246, *plates 86, 87* (*colored*). 8 Je 1899.

Vol. 6, No. 4; price, 50 cents:

Underwood, Lucien Marcus. A review of the genera of ferns proposed prior to 1832. Pages 247–283. 1 D 1899.

Vol. 6, No. 5; price, 25 cents:

Fink, Bruce. Notes on lichen distribution in the upper Mississippi Valley. Pages 285–307. 1 D 1899.

Vol. 7; price, $3.00:

Howe, Marshall Avery. The *Hepaticae* and *Anthocerotes* of California. Pages 1–208, *plates 88–122*. 5 Au 1899.

Vol. 8, No. 1; not furnished separately:

Lloyd, Francis Ernest. The comparative embryology of the *Rubiaceae*. Part I. Pages 1–26, *plates 1–4*. 26 Au 1899. Part II. Pages 27–112, *plates 5–15*. 15 F 1902.

Vol. 8, No. 2; price, $1.00:

Evans, Alexander William. The *Lejeuneae* of the United States and Canada. Pages 113–183, *plates 16–22*. 15 F 1902.

Vol. 8, No. 3; price, 75 cents:

Britton, Elizabeth Gertrude, & Taylor, Alexandrina. The life history of *Vittaria lineata*. Pages 185–211, *plates 23–31*. 30 Au 1902.

Vol. 9; price, $3.00:

Salmon, Ernest Stanley. A monograph of the *Erysiphaceae*. Pages 1–292, *plates 1–9*. 4 O 1900.

Vol. 10; price, $3.00:

Burgess, Edward Sandford. History of Pre-Clusian botany in its relation to *Aster*. Pages i–xii, 1–447. 22 N 1902.

Vol. 11, No. 1; price, $1.75:

Griffiths, David. The North American *Sordariaceae*. Pages 1–134, *plates 1–16*. 30 My 1901.

Vol. 11, No. 2; price, $1.75:

Hazen, Tracy Elliot. The *Ulothricaceae* and *Chaetophoraceae* of the United States. Pages 135–250, *plates 20–42*. 20 O 1902.

Vol. 12, No. 1; price, $1.50:

Northrop, Alice Rich. Flora of New Providence and Andros (Bahama Islands). Pages 1–98, *plates 1–19 — map*. 10 D 1902.

Vol. 12, No. 2; price, $1.00:

Banker, Howard James. A contribution to a revision of the North American *Hydnaceae*. Pages 99–194. 13 Je 1906.

Vol. 12, No. 3; price, 75 cents:

Kupfer, Elsie. Studies in plant regeneration. Pages 195–241. 10 Je 1907.

Vol. 13; price, $3.00:

Burgess, Edward Sandford. Species and variations of Biotian Asters, with discussion of variability in *Aster*. Pages i–xv, 1–419, *plates 1–13*. 15 Mr 1906.

Vol. 14, No. 1; price, $1.25:

Burlingham, Gertrude Simmons. A study of the *Lactariae* of the United States. Pages 1–109, *figures 1–15*. 26 My 1908.

Address: **TORREY BOTANICAL CLUB,**
Columbia University, New York City.

VOL. 35 OCTOBER, 1908 NO. 10

BULLETIN

OF THE

TORREY BOTANICAL CLUB

Editor

MARSHALL AVERY HOWE

Associate Editors

JOHN HENDLEY BARNHART
JEAN BROADHURST
PHILIP DOWELL
ALEXANDER WILLIAM EVANS
TRACY ELLIOT HAZEN
WILLIAM ALPHONSO MURRILL
CHARLES LOUIS POLLARD
HERBERT MAULE RICHARDS

CONTENTS

The ferns and flowering plants of Nantucket . . . EUGENE P. BICKNELL 471
Studies in the genus Gymnosporangium . . . . . FRANK D. KERN 499
INDEX TO AMERICAN BOTANICAL LITERATURE. 513

PUBLISHED FOR THE CLUB

THE NEW ERA PRINTING COMPANY
LANCASTER, PA.

THE TORREY BOTANICAL CLUB

President,

HENRY H. RUSBY, M.D.

Vice-Presidents,

EDWARD S. BURGESS, PH.D. JOHN HENDLEY BARNHART, A.M., M.D.

Recording Secretary,

C. STUART GAGER, PH.D.

Botanical Garden, Bronx Park, New York City.

Treasurer,

WILLIAM MANSFIELD, PHAR.D.

College of Pharmacy,

115 West 68th St., New York City.

MEETINGS

Meetings twice each month from October to May inclusive: the second Tuesday, at 8:00 P.M., at the American Museum of Natural History; the last Wednesday, at 3:30 P.M., in the Museum Building of the New York Botanical Garden.

PUBLICATIONS

All subscriptions and other business communications relating to the publications of the Club should be addressed to the Treasurer, William Mansfield, College of Pharmacy, 115 West 68th St., New York City.

Bulletin. Monthly, established 1870. Price, $3.00 a year; single numbers 30 cents. Of former volumes, only 24–34 can be supplied separately; certain numbers of other volumes are available, but the entire stock of some numbers has been reserved for the completion of sets. Manuscripts intended for publication in the BULLETIN should be addressed to Marshall A. Howe, Editor, New York Botanical Garden, Bronx Park, New York City.

Torreya. Monthly, established 1901. Price, $1.00 a year. Manuscripts intended for publication in TORREYA should be addressed to Jean Broadhurst, Editor, Teachers College, Columbia University, New York City.

Memoirs. Occasional, established 1889. (See last pages of cover.)

Preliminary Catalogue of Anthophyta and Pteridophyta within 100 miles of New York City, 1888. Price, $1.00.

Vol. 35 No 10

BULLETIN

OF THE

TORREY BOTANICAL CLUB

OCTOBER, 1908

The ferns and flowering plants of Nantucket — III

EUGENE P. BICKNELL

Since Part II of this paper was published, a visit was made to Nantucket, from June 7 to 20, for the purpose, primarily, of investigating the earlier *Carices*. Previous visits, always in the late summer and autumn, had necessarily missed those sedges which, after their flowering and fruiting period in the spring and early summer, may no longer be recognized. The *Carex* season on Nantucket, therefore, promised to be of more than ordinary interest, especially as the list of species credited to the island was manifestly far from complete. The event disclosed no less than thirteen *Carices* not previously met with, all but one of which were additions to the island's known flora.

Another interesting outcome of this visit was the addition of ten grasses to those previously enumerated. In this group, also, many new observations were made. The record of these may be deferred to an appendix, but, for the purpose of preserving the general sequence of species as far as published, the additions are here interpolated.

It follows from this visit to Nantucket in June that the remainder of this paper will not accord strictly with the statement made in the introduction that it is based solely on explorations conducted in the late summer and autumn. In general, however, this will remain true, and all facts derived from observations made exclusively in June will be so indicated in the text.

In connection with these observations it should be recorded that the spring season of 1908 on Nantucket was a very late and

[The BULLETIN for September, 1908 (35: 423–470. *pl. 29–35*) was issued 29 S 1908.]

backward one and that in May and June the island suffered from a protracted drought. My explorations found the ponds lower and the bogs drier than the experience of other years had ever found them to be, even at the end of summer.

GRAMINEAE (concluded)

In Part II. it was said that the number of grasses known to occur on Nantucket, exclusive of several well-marked varieties, was one hundred and four. This number may now be increased to one hundred and seventeen. Three common species unaccountably omitted from Part II. are here added.

CALAMAGROSTIS CANADENSIS (Michx.) Beauv.

In bogs everywhere; panicles dried by the end of August.

CALAMAGROSTIS CINNOIDES (Muhl.) Scribn.

Somewhat local but rather widely distributed; most common in the neighborhood of Tom Never's Swamp and in the "Woods." In full flower through late August and September.

AMMOPHILA ARENARIA (L.) Link.

Abundant, occurring in sandy places all over the island, even on Saul's Hills. In full flower through August and September.

Extreme forms of this grass show a marked divergence in the characters of the spike and flowers. The spike may be long and tapering, 3.5 dm. long and 1.5 cm. thick, the spikelets with narrowly attenuate and acute outer glumes becoming 1.5 cm. in length; or it may be linear-cylindric, the outer glumes puberulent, much less gradually attenuate, acutish or obtuse, and only 7–10 cm. long.

* ALOPECURUS GENICULATUS L.

Frequent in wet places in the meadows north of the town and along damp sandy cartways below the "Cliff." Just in full flower June 7, but many spikes immature.

This is the introduced plant as distinguished from the native *A. aristulatus* of Michaux. The latter plant seems to have been well understood by some of the fathers of our botany but to have almost fallen from recognition of late years. I do not think there need be any doubt that it is worthy of its old position. It is a more delicate grass than *A. geniculatus* and offers an immediate contrast by its glaucous character and paler green color. It is

further much less stiffly depressed and geniculate, or even erect, with longer, thinner leaves, having less inflated sheaths, and longer, more slender spikes of much smaller shorter-awned flowers. The glumes and flowering scales are also somewhat different in form and proportions. An obvious difference between the two plants at their flowering periods is the relative size and color of the anthers: in *A. geniculatus* they are often purple and are 1.5–2 mm. long, in *A. aristulatus* they are yellow and only one third that size.

There would seem to be a considerable difference of time between the flowering periods of these grasses, since *A. aristulatus* was found this last season at the Thousand Islands in full flower late in September.

ALOPECURUS PRATENSIS L.

Common and well established, mainly in fields and lots in the general town region; west to beyond Maxcy's Pond; east to Monomoy and Shawkemo, then in Polpis towards Quidnet; 'Sconset. Just in full flower June 7.

* AGROSTIS ALBA ARISTULATA A. Gray.

Pocomo, in sterile soil far from any cultivated ground. In full flower June 15.

Slender but rather stiff, in loose tufts; culms 1–2.5 dm. high, erect, mostly geniculate close to the base, the basal leaf-sheaths broadened and chaffy; leaves very narrow, erect, involute; panicles purplish, 2–10 cm. long, very narrow, with erect or erect-ascending short branches; outer glumes 1.75–2 mm. long, lemma 1.5–2 mm., palet .75–1 mm.; awns 2–3 mm. long, wanting in many flowers on some panicles.

A distinct-appearing grass needing critical study.

* **Agrostis antecedens** sp. nov.

Common in dry sandy places or sometimes in damp soil. In full flower June 7.

Erect, tufted or of somewhat scattered habit, mostly 1.5–2 dm. high (1–6 dm.), pale green, much tinged with purple; culms often slightly geniculate at the lower nodes; leaves slightly scabrous, short, erect, involute-filiform, mostly 2–6 cm. long, or, in stout forms, larger and flattened, becoming 1–2 mm. wide and 10 cm. long; ligule blunt or acute, lacerate, 0.5–4 mm. long; sheaths smooth or slightly roughened, shorter than the internodes;

panicle purple, at maturity more or less exserted, sometimes for 12 cm., the very rough branches erect, erect-ascending or slightly spreading, 1–2 dm. long, borne in whorls of 3–11 on the lower nodes and of 2–5 above; the internodes 2–4.5 cm. in length; branches 6–12 cm. long, branched usually well above the middle or towards the ends; spikelets clustered towards the ends of the short branchlets, mostly very short-pedicelled or some even subsessile; empty glumes 1–2 mm. long, subequal or unequal, acute to abruptly acuminate, scabrous on the keel; lemma 0.5–1 mm. long, blunt.

√Type deposited in the herbarium of the New York Botanical Garden.

Closely related to *Agrostis hyemalis*, with which it has hitherto been confused, but differing in many essential points. *A. antecedens* is a much smaller plant than *A. hyemalis*, commonly not over half the size, with much shorter and narrower involute leaves, their sheaths much shorter instead of longer than the internodes. In *A. hyemalis*, the ample diffuse panicle is ordinarily more or less included at its base and is often more than half the length of the entire plant; in *A. antecedens*, it is relatively much shorter, more or less peduncled, and differs further in relatively much shorter, less widely spreading branches, which are less numerous in the lower whorls and more numerous from the middle ones. In *A. hyemalis*, the branches are commonly branched at or below the middle; in *A. antecedens*, well above the middle or towards the end; also, the ultimate flowering branchlets are much shorter than in *A. hyemalis* and the flowers, which are on much shorter pedicels, are manifestly smaller and more clustered; the empty glumes are commonly less unequal, relatively broader and less tapering, but more acuminate, the scabrous dorsal nerve less pronounced, the lemma shorter and less acute, but relatively longer as compared with the empty scales.

The distinctness of the two plants is further attested by their different flowering periods, *A. antecedens* being primarily a grass of the spring and early summer, *A. hyemalis* of the midsummer and fall. Both species are common on Long Island, where *A. antecedens* comes into flower from the middle of May to early June and is in its prime by the middle of the latter month, although sometimes persisting into September, while *A. hyemalis* begins to bloom rarely earlier than July and may be found freshly in flower as late as mid-November.

On Nantucket, on June 18, both species were found growing in actual contact, *A. antecedens* being at the height of bloom, *A. hyemalis*, although larger throughout and much more leafy, not yet showing the first signs of flowering.

* SPHENOPHOLIS PALUSTRIS (Michx.) Scribn.

In a corner of Watt's Run Bog, June 15, growing rather sparingly but of full development, the most advanced plants just in flower. Lower sheaths pubescent; plant perfectly typical as distinguished from var. *flexuosa* Scribn.

* DANTHONIA COMPRESSA Austin.

Along a cart-path through a damp thicket in Squam, June 15; first flowers, but panicles not yet fully expanded.

POA TRIVIALIS L.

Very common generally; in full flower June 7.

* PUCCINELLIA DISTANS (L.) Parl.

Common along dry or damp clayey roadsides towards Brant Point and below the "Cliff," often in close association with *P. fasciculata*. In full flower June 7; overmature and mostly dried up and little noticeable by June 18.

The plant seems rather ambiguous in some of its characters as between *P. distans* and *P. airoides* (Nutt.) Wats. & Coult.

FESTUCA DURIUSCULA L.

Occasional in sandy lots and by roadsides on the outskirts of the town; in full flower June 8.

Taller than *Festuca ovina*, with puberulent leaf-sheaths and larger panicles, the flowering scales larger, sometimes almost hirsute-pubescent and longer-awned. This plant is referred to *F. duriuscula* on the strength of presumably authentic European specimens. It would seem to have been generally lost sight of in our manuals that the original description of this grass calls for hispid flowering scales — "spcis * * * hispidis" (Sp. Pl. 74. 1753).

BROMUS STERILIS L.

At a number of places by street-sides in the town, sometimes in abundance, as along Pleasant Street. In full flower June 7.

LOLIUM PERENNE L.

Frequent or common in the town and occasional at outlying points; 'Sconset. Just in flower June 7.

Mrs. Owen's record of this grass, which, it was thought, might perhaps have referred to *L. italicum*, is thus confirmed.

* AGROPYRON REPENS PILOSUM Scribn.; Rand & Redf. Fl. Mt. Des. Isl. 183. 1894; U. S. Dept. Agric. Div. Agrost. Bull. 4: 36. 1897.

Sandy shore of the harbor towards Brant Point and adjacent roadsides; in full flower June 20. Plant conspicuously bluish green and glaucous, in other respects agreeing precisely with Scribner's descriptions and appearing very distinct from the ordinary forms of *A. repens*.

* HORDEUM JUBATUM L.

A single vigorous cluster by a neglected street-side near the old wharves; spikes almost fully expanded June 12.

CYPERACEAE

As with the Gramineae, it is to be understood of the species in this family that they were found in mature condition from the middle of August until the middle of September unless it is otherwise stated.

CYPERUS DIANDRUS Torr.

Frequent in damp sandy places and low grounds.

* CYPERUS RIVULARIS Kunth.

Uncommon, growing with *C. diandrus* at two localities near the town and on the shore of Miacomet Pond.

CYPERUS NUTTALLII Eddy.

Very common in salt marshes and on the sandy shores of brackish ponds.

CYPERUS DENTATUS Torr.

Common, occurring at many localities in sand or sandy soil, especially on pond shores; occasional in dry places along roadsides. In great profusion at Tom Never's and Gibbs' ponds and about ponds on the south shore; Maxcy's Pond; Capaum Pond; Long Pond; not seen in northeast quarter.

In seasons favorable to its growth this species on Nantucket attains a very full development, the inflorescence becoming unusually broad and compound, with spikes 15–35-flowered and 8–16 mm. in length (var. *ctenostachys* Fernald, Rhodora 8: 126,

127. 1906). Under conditions in which its flowering vigor becomes impaired the plant takes on a remarkably different aspect by reason of much shortened spikes, and scales often of darker color and with more spreading tips. A few extreme examples of this reduced state were collected, showing many spikes not more than 5–7-flowered and only 3–5 mm. long, although occasionally an elongated, many-flowered spike was developed among the shorter ones on the same axis. This condition of reduced flowering vigor seems often to result from an increased vegetative impulse supplied by a very rich or a very wet soil. Under such conditions the inflorescence is often invaded by a vegetative tendency whereby some of the spikes become more or less proliferous or even wholly transformed into tufts of small leaves.

I have collected on Long Island rather a marked form of the longer-spiked state of this plant, in which the spikes were narrower than in the Nantucket plant, with more numerous and crowded, much shorter scales.

CYPERUS ESCULENTUS L.

Common in cultivated and neglected fields and roadsides. Along the sandy banks of the railroad near the town, on Aug. 28, 1904, were many stout plants bearing wide-spreading umbels with rays 10–14 cm. long and clusters of spikes 6 cm. across, the narrowly linear spikelets being about 1.5 mm. wide and becoming 2.5 cm. long. At the same place in 1906 the ordinary short-spiked state of the plant was alone found. This form of the plant with elongated spikes would ordinarily be referred to var. *angustispicatus* Britton or var. *leptostachyus* Boeckl., but there is a rarer and more distinct plant with the spikes paler in color and almost filiform-linear to which, perhaps, the name more particularly applies. At any rate, the long-spiked Nantucket plant would appear to be scarcely more than a state of the common species, illustrating that occasional elongation of the flowering axis to which so many of the Cyperaceae are subject.

* CYPERUS SPECIOSUS Vahl.

Rare; sandy shore of Sachacha Pond, Sept. 16, 1899 and Aug. 13, 1906, — a few dwarf plants 5–9 cm. high, with subsessile capitate spikes.

CYPERUS STRIGOSUS L.

Infrequent; in low grounds. The stout form of the plant (var. *robustior* Kunth) at Eatfire, with spikes 4–5 cm. thick and spikelets 2 cm. long.

* CYPERUS STRIGOSUS COMPOSITUS Britton.

Common in low grounds; spikes cylindric, dense, 2–3 cm. long, 1–2 cm. thick, usually of a brighter, more yellowish brown color than in *C. strigosus*. A well-marked plant, having claims to recognition as a distinct species.

Cyperus erythrorhizos Muhl. was recorded by William Oakes as having been found on Nantucket in 1829 (Hovey's Magazine, May 18, 1849, 219, 220). That the plant has not since been found on the island would not of itself be an adequate reason for not giving it a more formal place here. It so happens, however, that the species is closely counterfeited in appearance by forms of *Cyperus strigosus compositus*, so closely indeed, that when, recently, at the herbarium of the New York Botanical Garden, a specimen of the latter was laid on a sheet of *Cyperus erythrorhizos* it was remarked by a very high authority on the genus, that, at a little distance, the two specimens looked as if they might have grown from one root; without particular reference, therefore, to the scale characters and minuter anatomy one plant might easily be mistaken for the other, and in view of the possibility of this, remote though it be in the case of a record by Oakes, a rediscovery of the plant on Nantucket would be at least a reassuring event.

Cyperus macilentus (Fernald) comb. nov.

Everywhere in dry sandy soil, even at the highest points on Saul's Hills.

Professor Fernald has recently called attention (Rhodora 8: 128, 129. 1906) to the very obvious differences between typical *Cyperus filiculmis* Vahl and this plant of smaller spikelets and more northern distribution, separating it as var. *macilentus*. I have long regarded these plants as distinct or so nearly so that, whatever their precise relationship might be, it was to be expressed no more accurately by a trinomial than by a binomial designation.

CYPERUS GRAYI Torr.

In pure sand on dunes and wastes, frequent or rather common.

DULICHIUM ARUNDINACEUM (L.) Britton.

Fresh-water ponds and wet swamps ; very common.

* ELEOCHARIS OBTUSA Schultes.

Uncommon or rare and met with at only four stations : Cato's Pond ; roadside west of the town ; Pocomo ; pool by state road near 'Sconset. It appears to come into flower on Nantucket later than its normal flowering time in the same latitude. In 1889, 1904, and 1907, its most advanced heads were perfectly fresh at the middle of September ; in 1906, when observations did not extend beyond the middle of August, it was not seen at all.

ELEOCHARIS PALUSTRIS (L.) R. & S.

Common in the muddy borders of ponds and pools. Just in flower June 7 ; spikes dried after the middle of August.

* ELEOCHARIS GLAUCESCENS Willd.

In wet sand about the borders of Madequecham and Nobadeer Ponds on the south shore and Capaum Pond on the north shore, also in an overflowed muddy place in Quaise. In full flower June 15 ; in flower and fruit Sept. 2, 1904.

In wet sand the culms are extremely slender, even capillary, sometimes spreading or almost prostrate and only 5–15 cm. long ; in water or wet mud it becomes stouter, strictly erect, and sometimes 50 cm. tall.

Although this plant has received only scant recognition in our flora, even as a mere variety of *Eleocharis palustris*, I have little hesitation in restoring it to specific rank.

In *E. palustris*, the narrowly ovoid, usually tapering spikelets are 10–20 mm. long and arise between two opposite scales which terminate and are continuous with the culm ; in *E. glaucescens*, there is only one such scale and the smaller ovoid spikelets, 3–10 mm. long, receiving therefore unequal lateral support at the base, are often slightly oblique or may be easily deflected ; the scales of the spikelet are looser and less numerous than in *E. palustris*, in much fewer rows, broader and more concave, much deeper and brighter purplish brown in color, and usually quite without the green mid-vein often so conspicuous in the spikelets of *E. palustris*. The achene of *E. glaucescens* is usually slightly larger than in *E. palustris*, notwithstanding the smaller size of the plant, with slightly

longer and more conic tubercle. The sheaths in *E. glaucescens* are less striate than in *E. palustris*, the lower ones more shining and of a brighter purplish red color, the upper one much less oblique at the top, sometimes even quite truncate, and the cortex of the culm under a lens much more distinctly crystalline-punctiulate and more coarsely cellular. The anthers and stigmas of *E. palustris* are definitely longer and more slender than those of *E. glaucescens*. These observations were made by comparison of living plants on Nantucket and are confirmed by fresh specimens from Long Island also and by some general reference to herbarium material.

ELEOCHARIS ACICULARIS (L.) R. & S.

Frequent or common in wet places. In full flower in August and September; not observed in June.

* ELEOCHARIS TRICOSTATA Torr.

Almanac Pond, Sept. 19, 1907 — a considerable growth on the muddy shore, where the water had receded, the culms and spikelets in all stages of development from their earliest visible condition up to full maturity. A few yards away a dense growth of *Eleocharis palustris* covered the muddy level, but the two species were not found intermingling. At the same place, on June 18, was an abundance of *E. palustris* in full flower, but *E. tricostata* was not sufficiently advanced to be recognizable.

ELEOCHARIS TENUIS (Willd.) Schultes.

Abundant in low grounds. In full flower June 7; completely dried up in August.

* ELEOCHARIS ROSTELLATA Torr.

Abundant in salt marshes on Swain's Neck and adjoining shores of Bache's Harbor; also brackish marshes at Eatfire. Heads dried in August.

SCIRPUS NANUS Spreng.

Abundant in brackish mud about ponds on the south shore; shores of Hummock Pond. Spikes just appearing June 17.

SCIRPUS AMERICANUS Pers.

Very common on shores and in wet places generally. Just in flower June 7.

SCIRPUS VALIDUS Vahl.

Infrequent; Shawkemo, along a brackish creek; pool in Polpis; in a water-hole back of the shore at Capaum Pond; Miacomet Pond. Spikes just appearing June 7; fully mature August 16, 1906. Spikes ovoid to ovoid-oblong, 5–6 mm. long; achene about 1.5 mm. long, 1–1.25 mm. wide.

* SCIRPUS OCCIDENTALIS (S. Wats.) Chase.

Common in Hummock Pond in water off the shore. Agrees closely with Mrs. Chase's description (Rhodora, 6: 68–70. 1904) and matches well with the common plant of the St. Lawrence River about Alexandria Bay. The Nantucket plant is the form with dark brown spikes, not over 10 mm. long, borne in capitate clusters. Scales much longer and larger than in *S. validus*; achene 2–2.25 mm. long, 1.50–1.75 mm. wide. Spikelets just appearing June 7; fully mature August 15, 1906.

SCIRPUS PALUDOSUS A. Nelson.

Common in saline soil, especially about the south shore ponds. Spikelets beginning to appear June 7.

* SCIRPUS ROBUSTUS Pursh.

A luxuriant growth of this rush completely filled a wet depression among lumber piles near the old wharves, Aug. 15, 1906, occupying perhaps half a square rod; the plants were fruiting abundantly and were of unusual size, some being seven feet tall. In September, 1907, the colony had been much disturbed by a rearrangement of the lumber and in June, 1908, only a few plants remained, none being yet in flower. Nothing was seen of this species elsewhere on the island and its situation near the wharves suggests that it may have been introduced.

* SCIRPUS RUBROTINCTUS Fernald.

Frequent in the town region. In great abundance in a low field near the "Creeks," where it was first observed Aug. 15, 1906, apparently a second growth after mowing, since the field was green from the tufts of basal leaves, yet no stems could be found; damp lot south side of the town; borders of Lily Pond; at several places in damp fields west of the town and about Millbrook Swamp. Generally in full flower by June 15.

SCIRPUS CYPERINUS (L.) Kunth.

Common. Subject to much variation in the form of the inflorescence and in the time of flowering. A late-flowering form is tall and stout with stiff, much elongated inflorescence, often more foliaceous-bracted than in the earlier-flowering form and sometimes wholly green and immature in September when the latter growing with it is fully ripe; the base of the involucels is variable in color but is often a dull black.

Forms answering the description of var. *pelius* Fernald are frequent, intergrading variously with the more common form. The state of the plant with congested inflorescence (var. *condensatus* Fernald) was observed several times in its extreme phase; certain specimens appeared to represent a congested state of the var. *pelius* rather than of the typical form, which is also subject to the same variation.

* SCIRPUS PEDICELLATUS Fernald.

Infrequent. Typical examples were collected, as well as other specimens which are so close to *S. cyperinus* as to be only arbitrarily separable.

* ERIOPHORUM VIRIDE-CARINATUM (Engelm.) Fernald.

Watt's Run Bog, June 15, a scattered group of strongly developed plants conspicuous from the bright wool of the mature and falling spikelets. The wool is of silky character and tinged with palest buff. Near by, *Eriophorum tenellum* showed its inflorescence only just beginning to appear.

ERIOPHORUM TENELLUM Nutt.

Rather common. Long Pond; Maxcy's Pond; Waqutuquaib Pond; Pout Ponds and ponds to the eastward in Shawkemo Hills; several sphagnum bogs west of Sachacha; Watt's Run; ponds in Polpis. In favorable places conspicuous from its white wool by June 18; few spikelets remain after the middle of August.

Eriophorum gracile Koch is admitted in Mrs. Owen's catalogue, but as this species was formerly often confused with *E. tenellum* the record should now be substantiated.

ERIOPHORUM VIRGINICUM L.

Common in wet bogs generally and locally abundant.

The form with the heads white or nearly so, presumably var. *album* Gray, is occasionally met with, but, although the wool may

appear pure white I have invariably found that some slight brownish tinge was revealed to close inspection.

RYNCHOSPORA GLOMERATA (L.) Vahl.

Very common in low grounds.

RYNCHOSPORA ALBA (L.) Vahl.

Frequent or common in sandy swamps and cold bogs, often growing in wet sphagnum.

* RYNCHOSPORA TORREYANA A. Gray.

First found on Nantucket, August 30, 1904, between 'Sconset and Tom Never's Pond, scattered here and there along a damp, sandy, nearly obliterated cart-path through an open growth of low vegetation, its flower-clusters in all stages of development up to full maturity. On September 15, 1897, it was found in considerable abundance over a damp sandy level south of the 'Sconset road near the seventh mile-stone, about a mile from where it had been found three years before. Here it was associated with *Drosera filiformis*, *Blephariglottis Blephariglottis*, *Lycopodium alopecuroides*, and other interesting plants.

CLADIUM MARISCOIDES (Muhl.) Torr.

By many pond shores and in wet places except apparently along the south side of the island. Cranberry bog on the shore of Maxcy's Pond; Waqutuquaib Pond; completely filling a considerable boggy place among the dunes near North Pond; ponds in Polpis; Almanac Pond; abundant at southwest side of Sachacha Pond; borders of salt marshes at Eatfire and on Swain's Neck.

SCLERIA TRIGLOMERATA Michx.

A small scattered colony on a dry exposed hillside between Saul's Hills and Sachacha, Sept. 19, 1907; achenes unusually large, 3 mm. long, 2.5 mm. thick; leaves rather stiff, 2–4 mm. wide.

Included in Mrs. Owen's catalogue on the authority of Professor Edward S. Burgess. Professor Burgess writes me that he recalls having found the plant about 1882 on the south side of the island near the Weeweeder Ponds, this locality being over six miles from the second station here reported.

* CAREX INTUMESCENS Rudge.

Local on the western side of the island; at several places along the north side of Trot's Swamp; west of Trot's Swamp; the

"Woods"; Millbrook Swamp. Spikes very immature June 10; heads still green September 14, 1907.

CAREX LUPULINA Muhl.

Not common, but scattered here and there throughout the width of the island: ditch west of the town; near Long Pond; pool on the "Plains"; abundant at a small pond by the road west of Quaise; bog-holes south of Wauwinet. Spikes beginning to show June 9; still fresh after the middle of September.

* CAREX LUPULINA PEDUNCULATA Dewey.

A luxuriant growth about a pond hole almost hidden by dense thickets less than half a mile to the southeast of Bedlow's Pond; spikes fresh Sept. 19, 1907.

Appearing very distinct from typical *C. lupulina*, which seems to be very constant in its characters at the various localities where it occurs on Nantucket.

CAREX LURIDA Wahl.

Common in low grounds; examples approaching var. *flaccida* Bailey occasionally met with. Spikes very immature June 10; still fresh Sept. 15, 1907.

* CAREX UTRICULATA Boott.

Northern end of Millbrook Swamp, filling an inundated place of perhaps half an acre to the exclusion of all other vegetation. Fully mature and fruiting abundantly June 9. A tall, stout form of the plant, larger examples having leaves 5–10 cm. wide and spikes 4–10 cm. long by 1–1.5 cm. thick. Where the water had dried away at the edge of the bog many plants were much reduced in size, corresponding to Boott's var. *minor*; in these smaller specimens the leaves were only 2–6 mm. wide and the spikes 2–3 cm. long.

* CAREX BULLATA Schkuhr.

Very local, but growing in profusion at the few places where it is found. The narrow-spiked typical form occurs in a low meadow west of the town, mostly in the shade of bordering shrubbery and taller vegetation, where it was abundantly in flower but still immature on June 9. The broad-spiked form [*C. physaeina* Dewey, *C. bullata* var. *Greenii* (Boeckl.) Fernald] occurs in abundance in open, very wet sphagnum bogs in Quaise, and was

rather more mature than the narrow-spiked form at the same date. In a very wet place southwest of Sachacha Pond is a large patch of a form somewhat intermediate between its two extremes but apparently best referred to a small-spiked state of the broader-spiked form. Here the spikes were still green as late as September 19, 1904.

In their extreme states the broad-spiked and narrow-spiked forms of this plant present rather striking differences and appear quite distinct, but these differences are subject to a most confusing interchange in whole or in part, so that it is sometimes difficult to assign specimens to either form. My own observations on Long Island make it appear probable that the narrow-spiked form is a state which sometimes reflects conditions of greater shade, and again expresses a modified development through a drying up of the soil before the plant has reached its natural maturity. Contributory to this view is the fact that the narrow-spiked form seems to be quite generally infertile.

CAREX COMOSA Boott.

Rather common in wet places. Spikes just appearing June 15; still fresh at the middle of September. At Watt's Run with unusually narrow spikes simulating *C. pseudo-cyperus*.

* CAREX VESTITA Willd.

At a number of rather widely separated localities: Trot's Swamp; Millbrook Swamp; Quaise; Polpis; Tom Never's Pond and at several places about the borders of the swamp. In full flower June 10; no perigynia remaining August 7, 1906. Often occurs in wetter places than is usual for this species, sometimes even growing in wet sphagnum.

* CAREX WALTERIANA Bailey.

Occurs rather sparingly in a small bog south of the roadside fountain erected by the Commonwealth of Massachusetts to mark the birthplace of Abiah Folger Franklin, mother of Benjamin Franklin. In perfect fruiting condition June 10, 1908; perigynia wholly glabrous.

* CAREX LANUGINOSA Michx.

Meadow near Reed Pond, a slender form suggesting *C. filiformis* L. A very stout distinct-appearing form was collected in

a sphagnum bog in Quaise, June 11; the stiff nodulose leaves were unusually broad, even as wide as 6 mm.; the densely flowered spikes were 5–7 mm. thick, with perigynia 4.5 mm. long and 2.75 mm. thick, less spreading than in the ordinary form and with more deeply colored, appressed-ascending rather than spreading scales.

Carex filiformis L. of Mrs. Owen's catalogue may have referred to the slender form of *C. lanuginosa* mentioned above; at least, the record of *C. filiformis* should now be confirmed.

* CAREX HIRTA L.

Sparingly in a low field between the Point Breeze Hotel and the shore. Not fully mature June 7.

* CAREX STRICTA Lam.

Found only near Reed Pond, a fairly typical form, although only moderately tufted and not forming the strong, dense tussocks which are so characteristic of this sedge under favorable conditions. In full flower June 8.

Lower leaf-sheaths becoming strongly cross-fibrillose; leaves and culms much greener and rougher-margined than in *Carex Goodenowii*, the leaves longer and narrower; spikes more remote and narrower with more numerous, smaller, more acute, nerveless or obscurely few-nerved perigynia and narrower, more attenuate and much less deeply colored scales.

The plant grew in close association with *Carex Goodenowii* and the two species seemed to intergrade so perfectly that certain specimens appeared precisely intermediate and impossible of definite assignment to either.

Ill-defined and intergrading hybrids between very closely allied species scarcely seem to justify formal designation. Unproved, indeed, as most alleged hybrids are, their occurrence seems to be wholly dependent on chance conditions of unusual propinquity in the supposed parent species. Such intermediate plants seem to fall into a different category from that of well-defined intermediates of wholly detached existence as, for instance, some of the alleged hybrids in *Viola* which, if they be of hybrid origin, are perhaps none the less species because plants whose origin has not remained wholly concealed.

Nothing was seen of *Carex aquatilis* Wahl., which is named by Mrs. Owen. In the wide variation shown by *Carex Goodenovii* are taller, more leafy-bracted forms somewhat simulating forms of *C. aquatilis*, the record of which, on Nantucket, it seems proper, therefore, to place in abeyance until positive evidence of its occurrence is forthcoming.

CAREX GOODENOVII J. Gay.

One of the characteristic sedges of the island, growing everywhere in low grounds and wet places, often in such abundance as to tinge fields and meadows for rods together with the bluish green hue of its leaves or the dark color of its mature spikes. In full flower June 7; some green spikes are to be found as late as the middle of August and dried spikes over a month later.

In many of its characters this sedge exhibits unusually wide variations, but, great as these differences are, all appear to be variously interchangeable among the numerous forms which the species assumes and I have not been able to discover that any set of characters is ever associated so securely as to indicate any very strong subspecific tendency.

The form defined by Bailey as var. *strictiformis* (*Carex vulgaris* Fries, var. *strictiformis*, Mem. Torrey Club 1: 74. 1889) and attributed to Nantucket is readily enough recognized in its extreme state, but it is itself so variable and so confusingly involved with other forms that, as Professor Fernald has already concluded, there is no sound basis for its recognition (Rhodora 4: 224. 1902).

On Nantucket this *Carex* varies from 1 to 8 dm. in height, the leaves from longer than the culm to less than half its length and from 0.5 to 3.5 mm. in width, and in color from glaucous blue to nearly green; the spikes may be short-cylindric, stiff, and sessile, with closely crowded spreading perigynia, or narrowly linear, short-stalked and somewhat spreading and very loosely flowered; the perigynia vary from nearly orbicular and broadly rounded above to elliptic and obtuse or even to narrowly oblong and acute, and from faintly few-nerved to distinctly 7–11-nerved; the color at maturity varies from bright pale green or dull green to black-purple; the extremes of size and shape of the perigynia may be expressed by the measurements 3 × 3 mm. and 2–3.5 × 1.5 mm.; the scales, while always very dark in color and usually rounded-

obtuse and much shorter than the perigynia, are sometimes more elongated and acute or the lower ones even aristate; the staminate spikes may be 1 to 3, sessile or slender-stalked, and are very variable in size, shape, and color; frequently the fertile spikes are staminate at the apex and sometimes even at the base.

* CAREX GYNANDRA Schwein.

Uncommon, in sphagnum bogs, usually in the protection of bordering shrubbery: at several places in Watt's Run bog; Quaise, near Bache's Harbor; southwest side of Sachacha Pond. Freshly in flower June 10; perigynia brown and mostly fallen Sept. 17, 1897. Lower sheaths minutely pubescent.

* CAREX VIRESCENS Muhl.

C. virescens var. *minima* Barratt; Bailey, Mem. Torrey Club 1: 77. 1889.

C. virescens var. *Swanii* Fernald, Rhodora 8: 183. 1906. Rather common in grassy open grounds and thickets. Just in flower June 7; some spikes still green in early September, 1904.

I am unable to adopt Professor Fernald's view (*loc. cit.*) that the true *C. virescens* of Muhlenberg, published by Willdenow and by Schkuhr, is not our common short-spiked plant which has for so long a time borne the name, but the woodland plant with longer spikes, by Schweinitz described as *C. costata*, by Dewey as var. *costata*, and later by Doctor Britton, most certainly with ample reason, restored to full specific rank as *C. costellata*.

Both Willdenow's description and Schkuhr's figure, upon which Professor Fernald has based his readjustment of the nomenclature of these plants, afford to my mind convincing evidence that the long accepted application of the name *C. virescens* should have remained undisturbed.

Schkuhr's illustration presents one very young entire plant and the fruiting top of a plant nearly mature. The former is accurately shown with the spikes much more slender than they become when fully developed. The latter, although not representing the extreme of our shorter-spiked plant, corresponds precisely with frequent examples, even responding accurately to exact measurements of the spikes and their relative positions. The illustrations of the detached perigynia are even more unmistakable.

They are shown as broadly ovoid or obovoid without visible nerves and are not to be reconciled with the elliptic, conspicuously costate perigynia of *C. costellata*. Finally Bailey has put on record that he has examined the type of *C. virescens* in Willdenow's herbarium and in regard to it he has repeated in several places that it is our smaller shorter-spiked plant (Mem. Torrey Club 1: 61, 76, 78. 1889.)

* CAREX TENUIS Rudge.

Locally common but occuring only in a few localites: at several places in the "Woods" and along the borders of Trot's Swamp; copse on bank at Watt's Run. In perfect fruiting condition June 10; few perigynia remaining September 15, 1906.

CAREX PALLESCENS L.

Frequent or almost common, but somewhat local, although rather widely distributed over the island except apparently along the south side. Spikes of full size June 7.

CAREX PENNSYLVANICA Lam.

Abundant, sharing with *C. Goodenowii* and *C. cephalantha* the distinction of being one of the three most abundant *Carices* on the island. Fully mature June 7; readily recognizable from the leaves in the late summer and autumn.

The common woodland form with soft and very narrow elongated leaves is abundant over the moorland and in dry thickets. On the exposed plains the plant is lower and much stiffer-leaved and separates further into two forms which in their extreme phases are set off markedly from each other on close comparison. In one the pale leaves become stiff and coarse and over 3 mm. wide, and the stiff culms mostly 5–15 cm. high; in the other the leaves are narrower and rougher and the culms rather longer, although shorter than the leaves; in this also the perigynia are mostly larger than in the companion form and less abruptly rounded to a slightly longer sharper-toothed beak, the scales are also longer and sharper and commonly more spreading and more deeply colored.

* CAREX EMMONSII Dewey; Torr. Ann. Lyc. N. Y. 3: 411. 1836.
C. alpestris Dewey, Sill. Jour. I. 7: 268. 1824. *Fide* Torr.
C. alpestris Schwein. & Torr. Ann. Lyc. N. Y. 1: 341. 1825. Not Allioni, *fide* Torr.

C. Davisii Dewey, Car. 279. 1826. Not Schwein. & Torr.

C. varia, in part, of recent authors, not Muhl.

Common in dryish spots near damp or swampy ground, often in sandy soil, and in partial shade about the borders of low thickets. Fully mature June 9; in the summer and autumn, its low, close tufts of soft leaves make it easily recognizable, there being no species on the island with which it might be confused.

The name *Carex Emmonsii*, here restored to a place in our flora, has not been in use for many years. The plant so named by Dewey was denoted so explicitly in Torrey's "Monograph" that it is hard to understand how it could have remained for so long a period confused with the *Carex varia* of Muhlenberg. In 1889 (Mem. Torrey Club 1: 40, 41) Bailey showed that our common woodland *Carex* (*C. communis* Bailey), which had up to that time been known as *Carex varia* Muhl., was not the sedge to which this name rightly belonged. But in correcting one error another was committed, and his mistaken relegation of the name *Carex Emmonsii* to synonymy under *C. varia* Muhl. seems never to have been called in question. Nevertheless, I do not think it will be disputed by any one knowing the two plants that, although closely allied, they are yet perfectly distinct.

Carex Emmonsii often so closely resembles forms of *Carex albicans* Willd. and *Carex deflexa* Hornem. that it may be easily mistaken for them. Its relationship to these species is indeed close but, disregarding other characters, it may be readily distinguished from them by its narrower and longer-beaked perigynia.

Carex varia Muhl. is a plant of dry, open, hilly or rocky woodland. Its culms are mostly erect, noticeably surpassing the numerous very narrow leaves; the staminate spike is distinct, or even conspicuous, and commonly about 10 mm. in length, the mostly purplish pistillate spikes distinct or separated by definite intervals.

Carex Emmonsii differs in more slender, commonly prostrate culms, much surpassed by the tufts of elongated flexuous leaves, some of which become 2.5 mm. in width; staminate spike very small or inconspicuous, 2–6 mm. long, often partly pistillate at summit; fertile spikes contiguous in a short, close head, mostly

pale green; perigynia commonly narrower, greener and less pubescent, more attenuate at base and apex, the beak longer; scales of both fertile and staminate spikes longer and narrower, more attenuate and sharper and usually much paler in color or wholly white.

Carex Emmonsii is more of a shade plant than *Carex varia* and is most at home about the dryish borders of wet thickets or boggy places in the woods either on hills or in low grounds. On Long Island it is common on the coastal plain as well as on the hills; *Carex varia* occurs in drier, more open places on the hills but seems to be wholly absent from the coastal plain.

When these two plants are once understood I think there is little likelihood of their being mistaken for each other.

* CAREX UMBELLATA Schkuhr.

Common in sandy open ground; fully mature June 7 to 17. Perigynia 3.5–4 mm. long, 1.5–2 mm. wide, slightly pubescent to glabrate, more or less nerved, at maturity becoming distended, pulpy, and white at the base, the beak 1–1.5 mm. long; achene ovoid-subglobose, obscurely 3-sided, 1.5–1.75 mm. long, 1.25–1.50 mm. thick, dull grayish black or silvery, appearing minutely roughened.

This plant agrees so well with Schkuhr's illustration of *Carex umbellata* that there can be little doubt that it is definitely typical, although a form with longer-beaked, more pubescent perigynia would seem to have been commonly understood in that sense. The plant here in view, notwithstanding its comparatively short beak, is not the var. *brevirostris* Boott. The latter plant or one which must be referred to it on the basis of descriptions, is frequent on Long Island, N. Y., where the typical plant seems to be rare, the prevailing form being the var. *tonsa* Fernald. The var. *brevirostris* often occurs with the latter and differs from it constantly in definite characters. It commonly forms larger, closer tufts and has much longer, narrower, more erect and less rigid leaves and more slender culms, some of which are capillary and elongated and bear a slender-pedicelled, bracteate fertile spike near the base of the staminate one; the perigynia are mostly pubescent and only 2.5–3 mm. long, with the short beak only 0.5–1 mm., the achene pale brown, rather shining and about 1.5 mm. long by 1 mm. thick. I have long regarded this plant as a distinct species and

have deposited specimens from Richmond Hill, Long Island, in the herbarium of the N. Y. Botanical Garden labeled **Carex abdita.**

* **Carex tonsa** (Fernald) comb. nov.

Carex umbellata var. *tonsa* Fernald, Proc. Amer. Acad. 37: 507. 1902.

Common in the same situations as *Carex umbellata*; in exposed places with the perigynia nearly gone June 9; in the shade of pines still with full-flowered spikes June 17. Perigynia mostly about 4 mm. long by 1–1.5 mm. thick, nerved or nerveless, the slender often curved beak 2 mm. long; achene 1–1.25 mm. long by 0.75–1 mm. thick, trigonous-obovoid, chestnut-brown, often shining as if polished, contrasting even more markedly with that of *C. umbellata*, as described above, than with that of *C. abdita.*

In the autumn the plant may be readily recognized from its small tufts of stiff partly spreading leaves.

* CAREX LEPTALEA Wahl.

Along a mossy run through a sphagnum bog in Quaise, also Watt's Run Bog; fully developed June 1.

CAREX STIPATA Muhl.

Common in bogs and low grounds, often along brooks and ditches. In full flower June 7; a few perigynia accidentally persistent into September.

Remarkably large plants were found in a muddy thicket around a pot-hole near Tristram Coffin's Homestead in September, 1907; some of the bright green tufts were 12 dm. tall, with leaves 12 mm. wide, strongly 3-plicate and very roughly margined.

CAREX VULPINOIDEA Michx.

Frequent in low grounds. Spikes only beginning to appear June 9; perigynia falling or sometimes quite gone in September.

* **Carex annectens** comb. nov.

Carex xanthocarpa annectens Bicknell, Bull. Torrey Club 23: 23. 1896.

Uncommon or rare. 'Sconset, June 13, in damp spot at edge of field by a farmyard, immature — a somewhat reduced form, bractlets and awns of the scales conspicuous; ditch near the south shore between Hummock and Miacomet ponds, June 17, imma-

ture — a taller and stouter form, less conspicuously awned and bracteate.

Carex rosea Schkuhr is admitted by Mrs. Owen. This record seems to need confirmation, especially as the species is sometimes rather strikingly suggested by slender, few-flowered forms of *Carex cephalantha* Bailey.

*CAREX MURICATA L.

Thoroughly naturalized in the town region, often growing in dense tufts and in some places fairly massed along the fences bordering low fields and roadsides.

On Sept. 15, 1907, some of these luxuriant growths had become a tangle of widely overcurved and reclined culms, many of them 4 feet to 4 feet 10 inches in length and bearing dark brown heads of mature fruit. At the same time some thin tufts in a dry pasture west of the town bore short, nearly prostrate culms only 3–4 dm. long. Freshly in flower June 7. Not seen further from the town than about one mile out on the south side.

CAREX MUHLENBERGII Schkuhr.

Occasional or frequent in dry open places. Freshly in flower June 7; mostly beyond full maturity in September. Fully typical specimens were collected, as well as a smaller, more slender form in which the heads are 1.25–2.5 cm. long and the perigynia 3 mm. or less long and 1.5–2 mm. wide.

Carex cephalantha (Bailey) comb. nov.

C. echinata Murray var. *cephalantha* Bailey, Mem. Torrey Club 1: 58. 1889.

C. stellulata var. *cephalantha* Fernald, Rhodora 4: 222. 1902.

C. stellulata var. *excelsior* (Bailey) Fernald, *loc. cit.*

One of the abundant *Carices* of the island, occurring everywhere in open, low grounds and wet places. A considerable range of variation is shown, which appears to be largely a matter of relative vigor of growth. In its most reduced state the plant is 2–3 dm. high, the leaves 1 mm. or less in width, the 3–5 few-flowered subglobose spikes approximate in a head sometimes only 2 cm. long. From these smaller plants the gradation is insensible to the larger forms over 5 dm. tall, with heads 4–6 cm. long, of 5 or 6 many-flowered spikes, the lower ones well separated and

becoming cylindric and 10 mm. long. There seems to be no essential difference between the perigynia of the larger and smaller plants, although the latter sometimes show some approach to the narrower perigynia of var. *angustata*, but this form in its typical state was not met with. At a locality in Quaise the ordinary form of the plant was found passing into a state with flexuous or even nodding heads of scattered spikelets 1–2 cm. apart.

* **Carex incomperta** sp. nov.

Densely tufted, 4–6 dm. high, leaves numerous, bright green and rather soft, flexuous, much surpassing the culms, 1–2 cm. wide; culms slender, roughened towards the top; spikelets 3 or 4, contiguous or slightly separated in a head 1.5–2 cm. long, small, subglobose, mostly 5–6 mm. long and wide, 9–17-flowered, the terminal one often clavate at base; perigynia thin, flattened, deltoid-ovate, often subcordate, more or less striate-nerved on both faces, abruptly contracted into a prominent, narrow, slightly rough-edged beak one third to one half its length, finally wide-spreading; scales ovate, thin, pale, becoming slightly brownish, obtuse or acute, about two thirds the length of the perigynia.

Type from Nantucket, June 20, 1908, wet bog below the Sea Cliff Inn, deposited in herb. N. Y. Botanical Garden.

This *Carex* lies midway between *C. sterilis* Willd. and *C. cephalantha* (Bailey) and did it occur with them the evidence for hybridity would be not less convincing than that on which many a published hybrid is based. *C. sterilis*, however, does not belong to the Nantucket flora as far as known, and, should it possibly occur on the island, must be extremely rare and local.

Carex incomperta seems to be not common in herbaria but I have seen specimens, variously referred to *C. sterilis* and to *C. cephalantha*, which give it a range from Massachusetts to Michigan, New Jersey, and Georgia. Its broadly deltoid perigynia would, by the books, place it definitely with *C. sterilis*, yet after careful study I am unable to include it with that species, nor can I force it into *C. cephalantha* under any view of that species not too careless broad.

Compared with smaller forms of *C. sterilis*, the aspect of the head is so similar as sometimes to appear identical except to very close inspection, yet I cannot regard the two plants as in any way interrelated. *C. sterilis* differs materially in coarser habit, much

broader and shorter paler green leaves of obviously different cellular structure under a lens, larger and more numerously flowered spikelets, and shorter, broader, and more obtuse scales of firmer texture, differences which are especially obvious in the scales investing the clavate base of the terminal spike; the perigynia of *C. sterilis*, although not always broader, are of thicker texture, more strongly nerved and thick-margined, paler in color and less abruptly narrowed to a shorter, broader, more graduated, and rougher-edged beak.

As compared with *C. cephalantha*, the leaves are longer, softer, and of thinner texture, the spikes fewer, the scales paler, shorter, and much less attenuate and acute; the perigynia, in addition to the deltoid base, are much thinner, more coarsely nerved and much more abruptly narrowed to a narrower, shorter, and less rough-edged beak.

The plant might be compared to an overgrown *Carex interior capillacea* Bailey, from which, however, it is at once distinguished by the prominently narrow-beaked perigynium.

Although reluctant to add another species to this difficult group of sedges, I do not know how else to report this plant as a member of the Nantucket flora. There it grew in abundance, forming large tufts in a very wet bog below the cliff where it was collected on June 21.

Carex delicatula nom. nov.

C. interior capillacea Bailey, Bull. Torrey Club **20**: 426. 1893.

C. scirpoides capillacea Fernald, Rhodora **10**: 47, 48. 1908.

Bogs and wet thickets, common. Forming close tufts of very numerous, capillary, flexuous culms, 2–7 dm. long, the elongated leaves mostly less than 0.5 mm. wide. In full flower June 7; persisting spikelets are sometimes to be found as late as the third week in September.

* CAREX SEORSA E. C. Howe.

Sparingly in damp thicket at the west side of Trot's Swamp; in abundance in a wet thicket in Polpis; mature on June 10.

Carex disjuncta (Fernald) comb. nov.

C. canescens var. *disjuncta* Fernald, Proc. Amer. Acad. **37**: 488. 1902.

Common in swamps and very wet bogs; fully developed June 7; a few dried spikelets remaining Sept. 8, 1904.

Carex subloliacea (Laest.) comb. nov.

C. canescens var. *subloliacea* Laest. Nov. Act. Soc. Sci. Ups. II: 282.

Common in wet sphagnum bogs, sometimes growing with *Carex canescens* and perhaps intergrading or hybridizing with it, but in its perfectly developed condition a very distinct plant. Fully mature June 7; a few persisting perigynia Sept. 19, 1907.

Carex canescens var. *alpicola* Wahl. of Mrs. Owen's list (*C. brunnescens* Poir.) doubtless refers to the present plant.

CAREX SCOPARIA Schkuhr.

Common in low grounds. The state with more or less moniliform spike (var. *moniliformis* Tuckerm.) is frequent, as is also a reduced form corresponding to the var. *invisa* of *Carex hormathodes* Fernald. Very immature June 7, spikes mostly dried in September.

* CAREX STRAMINEA Willd.

Met with only at one locality, on the north side of Trot's Swamp, where it grew very sparingly on dry ground among scattered shrubbery; scarcely mature June 10.

Very slender, 4–5 dm. tall, the leaves 0.5–2 mm. wide; spikelets 2–5, small, on a weak or flexuous axis 2–3 cm. long, ovoid, abruptly contracted to a short, staminate base, rather closely ascending; perigynia mostly 3.5 mm. long by 1.75 mm. wide, more or less nerved on both faces, gradually narrowed into a rather broad and rough-edged beak; scales rather deep brown, the lower very obtuse, those above becoming more attenuate and acute.

* CAREX STRAMINEA ECHINODES Fernald, Proc. Amer. Acad. 37: 474. 1902.

Sparingly in damp ground at one place in the "Woods"; nearly mature June 17.

Slender, 4–6 dm. tall, the leaves 1–2.5 mm. wide; spikelets 5–7 in a more or less moniliform, straight or flexuous spike 2.5–3 cm. long, small, ovoid-subglobose, narrowed into a conspicuously chaffy, clavate base; perigynia early spreading, mostly 3 mm. long by 2 mm. wide, nerveless or nearly so on both faces, the body

nearly orbicular, abruptly narrowed or rounded to the narrow and conspicuous somewhat rough-edged beak; scales very thin, even the lowest acute, pale stamineous; achene definitely larger and plumper than that of the preceding, and elliptic-oblong instead of ovate.

The two sedges here compared appear to me to be distinct, especially by comparison of the perigynia and achenes, and if Professor Fernald's var. *echinodes* is properly represented by the plant here referred to it, I should feel that there was little reason to doubt that it should stand as a species.

CAREX SILICEA Olney.

Common in sand, mostly along and near the beaches, but sometimes on the higher parts of the island quite away from immediate saline influence — spikes well developed June 7; mostly dried by September.

CAREX HORMATHODES Fernald, Rhodora 8: 165. 1906.

Very common in low, open grounds, and apparently less restricted to the neighborhood of salt marshes than in many localities along the coast. Spikes well developed June 7; spikelets mostly dried or gone by September. Probably the *C. straminea* of Mrs. Owen's list.

The so-called var. *invisa* (Boott) seems to be nothing more than a reduced and often late-flowering state of the plant to which there is no greater reason for according varietal status than for deducing varieties from parallel reduced states of almost all of its near relatives in the *Ovales*.

Where this species grows in abundance with *C. albolutescens*, occasional plants are so nearly intermediate that, except for the absence of actual proof, they might well be pronounced hybrids. Likewise, specimens were found which appeared quite intermediate with *C. scoparia*.

CAREX ALBOLUTESCENS Schwein.

Common near the beaches and salt marshes but also in wet places generally. In fresh-water swamps and about the borders of ponds a form occurs with greener, softer leaves and culms, and often longer heads of less approximate spikes, which are longer and more acute, with longer and narrower perigynia, narrower achene and more straminеous scales; in this form the spikes be-

come 7–10 mm. long and the perigynia 4–4.5 mm. A reduced fresh-water form has heads sometimes not over 5 mm. long and perigynia only 2–2.5 mm. in length.

This is doubtless the *C. adusta* of Mrs. Owen's catalogue and probably also the *C. straminea* var. *alata*.

Studies in the genus Gymnosporangium*

FRANK D. KERN

The first systematic study of the genus *Gymnosporangium* as it occurs in America was published by Farlow in 1880 in a paper entitled "The Gymnosporangia or Cedar-Apples of the United States."† European investigators had demonstrated several years earlier ‡ the genetic connection between members of the genera *Gymnosporangium* and *Roestelia*, and it was the desire to study the development of the American species in a similar manner which led to this attempt to define the species morphologically. Such a course was especially necessary because of the variety of forms inhabitating the same host, and the consequent small amount of aid which the host furnished in defining the limits of the various forms or species as they were believed to be. For instance, the earlier artificial cultures in America showed that infection on *Amelanchier* leaves was obtained from the sowing of spores of six apparently distinct species of *Gymnosporangium*, four of which occurred on the red cedar, *Sabina virginiana*. The necessity of following up these cultures and determining whether uniform and recognizable differences were evident in the resulting roestelial forms became at once apparent.

For eleven years, or until 1891, work on this group, by means of anatomical studies supplemented with cultures, was kept up by Farlow and Thaxter. During this period six species of *Gymnosporangium* were successfully connected to their roestelial phase, only one being a repetition of European investigations. The more important results are contained in the following papers: "Notes on some Species of *Gymnosporangium* and *Chrysomyxa* in the United States," by W. G. Farlow;§ "The Development

* Read before Section G of the American Association for the Advancement of Science, at the Chicago meeting, January 2, 1908.

† Anniv. Mem. Boston Soc. Nat. Hist. 1880.

‡ Bot. Zeit. **23**: 291. 1865; **25**: 222. 1867. Overs. Danske Vid. Selsk. Forh. **1866**: 185–196. *pl. 3, 4.* 1866. Bull. Soc. Roy. Dan. Sci. **1866**: 15, 16. 1866.

§ Proc. Amer. Acad. **20**: 311–328. 1885.

of the *Gymnosporangia* of the United States," by W. G. Farlow *; "On certain Cultures of *Gymnosporangium*, with Notes on their *Roesteliae*," by Roland Thaxter †; "Notes on Cultures of *Gymnosporangium* made in 1887 and 1888," by Roland Thaxter ‡; and "The Connecticut Species of *Gymnosporangium* (Cedar Apples)," by Roland Thaxter. § Besides these there have appeared numerous other notes dealing chiefly with the economic importance and genetic connection of certain species, the results serving to confirm the facts given in the papers mentioned.

In addition to ascertaining how many valid species existed in this country, the earlier workers met with the difficulty of deciding how many of these they recognized were like those already described in Europe. With a comparatively small number of specimens and those from a limited area in the New England and other eastern states, together with incomplete culture data, it is not a matter of surprise that some wrong references should be made which might later be explained and adjusted, but which, in some instances, have not been so treated up to the present time.

The foregoing is a brief statement of the problems encountered by those who began the systematic study of the genus *Gymnosporangium* in this country, with an abstract summary of the published results. Since the date of the last paper mentioned, 1891, there has been some increase of information concerning the group, and a gradual accumulation of specimens in herbaria, but there is practically no more available fundamental knowledge, in so far as published accounts are concerned.

In taking up the study of the group recently, much difficulty was experienced, therefore, and making headway was slow at first, partly due to the chaotic condition of the data left by the past workers, but due also to the fact that it was insufficient when put into usable form. These difficulties have been met and are being largely overcome, for the present, by the selection of new diagnostic characters, not heretofore employed, and by the detailed study and comparison of a large number of specimens from practically the whole geographical area of the United States and repre-

* Bot. Gaz. 11 : 234–241. 1886.
† Proc. Amer. Acad. 22 : 259–269. 1887.
‡ Bot. Gaz. 14 : 163–172. 1889.
§ Bull. Conn. Agric. Exper. Station 107. 1891.

senting nearly all possible ecological conditions. This method of treatment has revealed some undescribed species and the existence of some foreign species not before recognized. In Dr. Dietel's account of the genus *Gymnosporangium* in Engler and Prantl's Natürlichen Pflanzenfamilien in 1897 * he ascribed eight species to North America. This account omitted one which was known at that time and should have been included. Two more were described shortly after this work appeared. In a recent paper the writer has described three new forms of *Gymnosporangium* and three of *Roestelia*, all from the Rocky Mountains or the west coast.† The present paper characterizes three more forms and includes one foreign species recently reported from this country,‡ making in all a total of eighteen species under consideration.

The study of the relationship between the rust species and the host species is now rendered more complicated than it was formerly, owing to the much larger number of rusts recognized on the same number of hosts. In the telial stage, the species of rust, so far as is now known, infest the family *Juniperaceae*, represented by four genera, *Sabina*, *Juniperus*, *Chamaecyparis*, and *Libocedrus*.

On the genus *Sabina* are found twelve species of rust, of which eight inhabit the one host species, *Sabina virginiana*, four of the eight not occurring on any other species of *Sabina*. Four species occur on *Juniperus*, two on *Chamaecyparis*, and one on *Libocedrus*. It is a remarkable fact that each of the *Gymnosporangium* species is confined in the telial stage to a single genus of host plants, with the exception of one, which is reported on both *Sabina* and *Juniperus*, and there is a suspicion that here two species may really exist.

It is a notable fact that in the genus *Gymnosporangium* belong the only rusts which are heteroecious and yet do not possess all spore-forms, the uredinial stage being lacking in all the species. There is known a uredo-form on Juniperaceae from Alaska,§ how-

* E. & P. Nat. Pflanzenfam. 1[1**]: 50. 1897.

† New western species of *Gymnosporangium* and *Roestelia*. Bull. Torrey Club 34: 459–463. 1907.

‡ The existence of *Roestelia penicillata* and its telial phase in North America. Science II. 27: 931. 1908.

§ Harriman Alaska Expedition 5: 36. 1904. *Uredo Nootkatensis* Trel. on *Chamaecyparis Nootkatensis*.

ever, which may prove a possible exception to the foregoing statement. There is but one collection of it and so little is known that nothing positive can be stated but it seems probable that it should have a telial stage like *Gymnosporangium*, and be heteroecious with a roestelial stage on some of the *Malaceae*.

Gymnosporangium as a genus is characterized in the telial stage by teliospores having hyaline pedicels, usually of great length, which swell in moisture and often become gelatinized to form a jelly-like matrix in which the spores appear to be imbedded. Of interest in connection with the development of this stage are peculiar distortions which are usually produced either in the leaves or branches.

For the purpose of bringing together the data in such a manner as to be of material assistance in the determination of specimens, a key, involving the more evident diagnostic characters of the telia of the known North American species, and indicating the hosts for each one, is presented herewith. Preceding the key, notes are given for some of the species, explanatory of nomenclature, important extensions in range, and other interesting features which have been revealed in these investigations.

GYMNOSPORANGIUM BERMUDIANUM (Farl.) Earle, in Seym. & Earle Econ. Fungi *249*. 1893

This is the most curious of all the species of *Gymnosporangium*, being the only one which is not heteroecious. The aecial stage is a geniune *Roestelia*, developing in the fall on small, irregular, globoid galls, and is followed in the spring by telia on the same galls. The telia are very inconspicuous and may be easily overlooked in the dried condition of herbarium specimens.

GYMNOSPORANGIUM JUNIPERI-VIRGINIANAE Schwein. Schr. Nat. Ges. Leipzig 1: 74. 1822

The name *Gymnosporagium macropus* Link (Willd. Sp. Pl. 6: 128) is often used in referring to this species but as it was published in 1825, the one established by Schweinitz in 1822 must be accepted as the valid name.

Gymnosporangium floriforme Thaxter, sp. nov.*

Pycnia epiphyllous, numerous, gregarious, on discolored spots, punctiform, honey-yellow becoming blackish, subglobose, 150–175 μ in diameter.

Aecia hypophyllous, rather widely separated in oblong-annular groups 2–6 mm. across, on discolored spots, at first cylindrical, 1–1.5 mm. high, 0.2–0.5 mm. in diameter; peridium soon becoming finely fimbriate and strongly revolute; peridial cells long and narrow, 10–14 μ × 65–85 μ, becoming curved when wet; aeciospores angular-ellipsoid, 18–23 μ × 23–29 μ; wall chestnut-brown, 1.5–2.5 μ thick, finely verrucose; germ pores 6–8, scattered.

On *Crataegus spathulata* Michx., Auburn, Lee County, Alabama, October 21, 1897, *F. S. Earle & C. F. Baker;* October, 1897 *F. S. Earle* (in Sydow, Uredineen no. *1194*); October (year not given) *G. F. Atkinson;* Hot Springs, Arkansas, September 3, 1897, *Wm. Trelease.*

Telia scattered on globose or reniform galls, conical or cylindrical-acuminate, becoming 3–10 mm. long, 1-1.5 mm. wide, chestnut-brown becoming yellowish and pulverulent by germination, surrounded by the ruptured epidermis; teliospores 2-celled, narrowly ellipsoid, 15–19 μ by 39–50 μ, rounded both at apex and base, slightly or not constricted at the septum; wall pale cinnamon-brown, 1–1.5 μ thick, smooth; pedicel hyaline, very long, 3–6 μ in diameter; germ pores 2, near the septum.

On *Sabina virginiana* (L.) Antoine (*Juniperus virginiana* L.), Auburn, Lee Co., Alabama, March 11, 1897, *F. S. Earle* (type);

---

*Pycniis epiphyllis, numerosis, in greges dispositis, maculis decoloratis insidentibus, punctiformibus, melleo-flavis, demum atrescentibus, subglobosis, 150–175 μ diam.

Aeciis hypophyllis, in greges oblongo-annulatos 2–6 mm. diam. laxe dispositis, maculis decoloratis insidentibus, primo cylindraceis, 1–1.5 mm. altis, 0.2–0.5 mm. diam.; peridio mox multifido-fimbriato, fimbriis multum revolutis; cellulis peridii longis et angustis, 10–14 μ × 65–85 μ, humidis flectentibus; aeciosporis angulato-ellipsoideis, 18–23 μ × 23–29 μ; episporio castaneo-brunneo, 1.5–2.5 μ crasso, subtiliter verruculoso; poris germinationis 6–8, sine ordine dispersis.

In foliis *Crataegi spathulatae* in Alabama et Arkansas.

Teliis in caespites globosos vel reniformes dispersis, conoideis vel cylindrico-acuminatis, demum 3–10 mm. longis, basi 1–1.5 mm. latis, castaneo-brunneis dein aurantiacis et pulverulentis, epidermide rupta cinctis; teliosporis uniseptatis, angusto-ellipsoideis, 15–19μ × 39–50μ, apice et basi rotundatis, medio non v. vix constrictis; episporio dilute cinnamomeo-brunneo, 1–1.5μ crasso, levibus; pedicello hyalino, longissimo, 3–6μ diam.; poris germinationis binis juxta septum instructis.

In foliis ramulisque *Sabinae virginianae* (*Juniperi virginianae*) Auburn, Lee Co., Alabama, Mar. 11, 1897, *F. S. Earle.*

March 7 and 14, 1896, *Underwood & Earle;* Daytona, Florida, February, 1887, communicated by Dr. Roland Thaxter; Columbus, Mississippi, April 5, 1896, *S. M. Tracy.*

This species is morphologically very similar to *Gymnosporangium Juniperi-virginianae*, but there are some constant differences in the shape of the spore-masses and galls. The spore-masses are darker, shorter, and more conical, while the galls have a peculiar brownish luster. Cultures have been made by Dr. Roland Thaxter at Cambridge, Mass., and by Prof. F. S. Earle at Auburn, Ala., establishing the connection between this and the roestelial form on *Crataegus spathulata.** As a further characteristic, Dr. Thaxter has pointed out in a letter to the writer that it takes this species longer to mature its roestelial form than any other species known to him. The telial stage was fairly well characterized by Underwood and Earle (Bot. Gaz. **27**: 256) in 1896, but no name was employed. In the following year the same authors, in Bull. 80 of the Alabama Experiment Station, p. 218, applied the name *Roestelia flaviformis* without any accompanying description, to the stage on *Crataegus spathulata*, citing Atkinson as an authority. Later, when cultures had proven the connection between the new *Gymnosporangium* on cedar and the *Roestelia* on *Crataegus spathulata*, the combination *Gymnosporangium flaviforme* (Atks.) Earle was made by Earle, *loc. cit.*, without a description. The name *flaviformis* was a misinterpretation of *floriformis*, a herbarium name attached by Thaxter in the Atkinson herbarium.† After consulting with Dr. Thaxter it was decided as preferable to take up the original name *floriforme.* Having furnished notes and specimens and being the author of the name he is cited as the authority.

GYMNOSPORANGIUM CLAVARIAEFORME (Jacq.) DC. Fl. Fr. **2**: 217. 1805

This is the most widely distributed of the three European species found in North America, reaching from the Atlantic states into the heart of the Rocky Mountains. The roestelial stage has

---

* See Earle, Contr. U. S. Herb. **6**: 186. 1901.

† Farl. Bibl. Index **1**: 44. 1905. "The name *Roestelia flaviformis* given below is a misprint for *Roestelia floriformis*, Thaxter in Herb. Atkinson of which no description has been published. See *Gymnosporangium flaviforme* Earle."

been known from the western mountains for some time and it has been assumed that the telial stage must also exist there.* Several fine collections made by Professor E. Bethel in Colorado have verified the correctness of this assumption.

GYMNOSPORANGIUM ELLISII (Berk.) Farl. in Ellis, N. Am. Fungi, *271*. 1879

The connection between this *Gymnosporangium* and *Roestelia transformans* Ellis has been accepted almost without question for many years and there are reasons for believing it correct, but it may be noted that the culture record is much less authoritative than for most of the other species. Cultures were attempted by Thaxter in 1886 and an examination of his report in the Proc. Am. Acad. **22**: 264 shows that as a result of the sowing of the *Gymnosporangium* on detached leaves of *Pyrus* (*Aronia*) *arbutifolia*, an effect was said to be manifest in about eight days on the *Pyrus* leaves but no roestelial form or even pycnia ever developed. So far as the writer knows, this is the only published account referring to cultures of this species.

GYMNOSPORANGUM SPECIOSUM Peck, Bot. Gaz. **3**: 217. 1879

Although this species has been recognized for a good many years all attempts to connect an aecial form with it have failed. There is in its region no unattached species of *Roestelia* known with which it may be associated and there is not the slightest clue as to what the other stage may be.

GYMNOSPORANGIUM JUNIPERINUM (L.) Mart. Fl. Crypt. Erlang. 333. 1817

Under this name is here included the telial form of *Roestelia penicillata* (Pers.) Fries, which has been usually referred to by European writers as *Gymnosporangium tremelloides* Hartig, since he proposed that name in 1882, and not the telial form of *Roestelia cornuta* (Pers.) Fries. A brief statement of this conclusion has been made by the writer in Science **27**: 931. 1908.

* See Pammel, Bull. Iowa Experiment Station **84**: 32. 1905.

Gymnosporangium germinale (Schwein.) comb. nov.

The full synonomy of this species, which shows that the aecial stage was collected and described many years in advance of the telial stage, is here given.

Caeoma (Peridermium) germinale Schwein. Proc. Am. Phil. Soc. **4**: 294. 1832.

Peridermium (Caeoma) germinale Schwein. Proc. Am. Phil. Soc. **4**: 310. 1832.

Podisoma gymnosporangium clavipes C. & P. Jour. Quek. Club **2**: 267. 1871.

Gymnosporangium clavipes C. & P. Ann. Rep. N. Y. State Mus. **25**: 89. 1873.

Roestelia aurantiaca Peck, Ann. Rep. N. Y. State Mus. **25**: 91. 1873.

Puccinia clavipes Kuntze, Rev. Gen. Pl. **3**: 507. 1898.

Tremella clavipes Arth. Proc. Ind. Acad. Sci. **1900**: 135. 1901.

Aecidium aurantiacum Farl. Bibl. Index **1**: 19. Not *A. aurantiacum* Bon. 1860.

Aecidium germinale Arth. Result. Sci. Congr. Bot. Vienne 343. 1906.

Gymnosporangium Botryapites (Schwein.) comb. nov.

This is another instance in which the aecial name is much older than the telial one and becomes the name of the species. The synonymy is as follows.

Caeoma (Roestelia) Botryapites Schwein. Proc. Am. Phil. Soc. **4**: 294. 1832.

Ceratites (Caeoma) Botryapites Schwein. Proc. Am. Phil. Soc. **4**: 310. 1832.

Gymnosporangium biseptatum Ellis, Bull. Torrey Club **5**: 46. 1874.

Roestelia Ellisii Peck, Bull. Torrey Club **6**: 13. 1875.

Roestelia Botryapites C. & E. Grevillea **5**: 34. 1876.

Puccinia Botryapites Kuntze, Rev. Gen. Pl. **3**: 608. 1898.

Tremella Botryapites Arth. Proc. Ind. Acad. Sci. **1900**: 135. 1901.

Aecidium Botryapites Farl. Bibl. Index **1**: 22. 1905.

Gymnosporangium Davisii sp. nov.*

Telia chiefly epiphyllous, oval or oblong, 0.7–1 mm. broad, 1–2 mm. long, hemispherical, 0.5–1 mm. high, chocolate-brown, surrounded by the ruptured epidermis; teliospores 2-celled, broadly ellipsoid, 18–28 μ × 40–55 μ, usually narrowed at the base, apex often attenuated, usually furnished with hyaline papillae 4–7 μ thick at the apex and often near the septum in each cell, slightly or not constricted at the septum; wall cinnamon-brown, 1–1.5 μ thick; pedicel hyaline, very long, 3–5 μ in diameter; germ pores one or two, apical or near the septum.

On *Juniperus sibirica* Burgsd. (*Juniperus nana* Willd., *Juniperus communis alpina* Gaud.) Wind Lake, Racine Co., Wisconsin, May 7, 1905 (type), May 22, 1904, *J. J. Davis*; Isle au Haut, Maine, September, 1903, *J. C. Arthur*.

There have been made in this country several collections of this small, inconspicuous form. It is very characteristic and unlike any other so far reported from this country. It occurs chiefly on the leaves, although it may be found sometimes on the smaller stems at the bases of the leaves. The finest specimens are those collected by Dr. J. J. Davis, of Racine, Wis., in the edge of a tamarack swamp near Wind Lake, Racine County, Wis. Unmistakable traces of the same form were found by Dr. J. C. Arthur of Purdue University at Isle au Haut, Maine, but owing to the lateness of the season, it being September when his search was made, no spore-masses remained on the leaves. The spores are readily distinguishable from all other American forms, now known, by the presence of hyaline papillae over the germ pores. In this respect they are very much like the form said to be culturally connected in Europe with *Roestelia cornuta* (Pers.) Fries. However, the American form both at Wind Lake and at Isle au Haut is reported by Drs. Davis and Arthur to be intimately

---

*Teliis plerumque epiphyllis, ovatis v. oblongis, 0.7–1 mm. latis, 1–2 mm. longis, hemisphaericis, 0.5–1 mm. altis, fusco-brunneis, epidermide rupta cinctis; teliosporis uniseptatis, late ellipsoideis, 18–28 μ × 40–55 μ, basi plerumque angustatis, apice saepe attenuatis, apice et saepe juxta septum in quaque cellula papillis hyalinis 4–7 μ crassis praeditis, medio non v. vix constrictis; episporio cinnamomeo-brunneo, 1–1.5 crasso; pedicello hyalino, longissimo, 3–5 μ diam.; poris germinationis apice v. juxta septum singulis v. binis instructis.

In foliis ramulisque *Juniperi sibiricae* (*Juniperi nanae*), Wind Lake, Racine Co., Wisconsin, Maio 7, 1905, *J. J. Davis*.

associated with an aecial form on *Aronia*. This *Roestelia* on *Aronia* resembles in general appearance the *Roestelia cornuta* (Pers.) Fries on *Sorbus*, but a microscopical examination shows that it is morphologically distinct. This fact has assisted in arriving at the conclusion that the telial form under discussion is not identical with the one connected to *Roestelia cornuta* on *Sorbus* in Europe, and it is therefore characterized as a new species. It is hoped that cultures may soon be made which will give additional information. In the selection of a name the author has taken the opportunity to show his regard for the valuable services rendered to mycology by Dr. Davis and especially appreciation of his assistance in the study of this species. It may be added here that *Roestelia cornuta* on *Sorbus* occurs in this country but no telial form has ever been found associated with it.

Gymnosporangium exiguum sp. nov.*

Telia foliicolous, scattered irregularly, tongue-shaped or conical, small, 0.5–1 mm. thick, 1–1.5 mm. high, chestnut-brown; teliospores 2-celled, ellipsoid, 18–23 μ × 45–55 μ, rounded or slightly narrowed both above and below, slightly or not constricted at the septum; wall cinnamon-brown, about 1.5 μ thick; pedicel hyaline, 5–6 μ in diameter, long; germ pores 2 in each cell near the septum.

On leaves of *Sabina virginiana* (L.) Antoine (*Juniperus virginiana* L.), Fredericksburg, Texas, March, 1895, *F. Grasso.*

On leaves of *Sabina sabinoides* (H.B.K.) Small (*Juniperus sabinoides* Sargent), Austin, Texas, March and April, 1901, *W. H. Long.*

This is a very delicate and inconspicuous species. It somewhat resembles *G. Nelsoni* but differs in its distribution on the host and in the shape of the sori. It differs from *G. inconspicuum* by having slender terete pedicels instead of inflated ones. There is at

---

* Teliis foliicolis, irregulariter dispositis, liguliformibus vel conoideis, parvis, 0.5–1 mm. crassis, 1–1.5 mm. altis, castaneo-brunneis; teliosporis uniseptatis, ellipsoideis, 18–23 μ × 45–55 μ, apice et basi rotundatis vel interdum conico-angustatis, medio non vel vix constrictis; episporio cinnamomeo-brunneo, ca. 1.5 μ crasso; pedicello hyalino, 5–6 μ diam., longo; poris germinationis binis juxta septum instructis.

In foliis *Sabinae virginianae* (*Juniperi virginianae*) Fredericksburg, Texas, Mar. 1895, *F. Grasso.*

present no roestelial form recognized from this region which may be associated with this species.

Gymnosporangium Libocedri (Henn.) comb. nov.

In 1890 H. Mayr used the combination *Gymnosporangium Libocedri* in his work "Die Waldungen von Nordamerika" but he did not describe the fungus he referred to in such a way as to establish the name. In 1898 P. Hennings described in Hedwigia **37**: 271 a species of rust which he evidently took to be the same as the one Mayr had referred to but named it *Phragmidium Libocedri*. Sydow was the next to study the *Libocedrus* rusts and a full account of his observations is given in the Annales Mycologici **2**: 28. After considerable investigation he came to the conclusion that Hennings' name should be considered a synonym of Mayr's and that they referred to a species distinct from one that he had at hand which had been recently collected in California by E. B. Copeland. He therefore proposed the name *Gymnosporangium aurantiacum* for his species. Later on Sydow obtained some of Hennings' material and made out that the form described as *Phragmidium Libocedri* was identical with his *Gymnosporangium aurantiacum*. The writer has also examined original material of both these collections and finds this to be the case. The older specific name of the species is *Libocedri* and since Mayr's name is a *nomen nudum* there is nothing to prevent the combination *Gymnosporangium Libocedri* (Henn.) as here proposed. Sydow's specific name *aurantiacum* could not stand in any event as there is a *Gymnosporangium aurantiacum* of Chevallier, Fl. Env. Paris **1**: 424. 1826.

Key to the telia

Telia appearing on galls.
  Galls globoid or reniform.
    Telia pulvinate, low, inconspicuous..... *Sabina barbadensis*, *Sabina bermudiana*, *Sabina virginiana* — *G. bermudianum* (Farl.) Earle. (Seym. & Earle, Econ. Fungi 249. 1893.)

Telia terete.
  Telia cylindrical or cylindrical-acuminate, golden-brown... *Sabina virginiana* — *G. Juniperi-virginianae* Schwein. (Schr. Nat. Ges. Leipzig 1: 74. 1822.)

Telia somewhat conical, chest-nut-brown..... *Sabina virginiana*.... *G. floriforme* Thaxter.

Telia laterally compressed.

Telia thick, wedge-shaped, chestnut-brown.. *Sabina virginiana* { *G. globosum* Farl. (Anniv. Mem. Boston Soc. Nat. Hist. 34. 1880.)

Telia thin, irregularly flattened, light chestnut-brown..... { *Sabina utahensis* / *Sabina monosperma* } { *G. durum* Kern. (Bull. Torrey Club 34: 460. 1907.)

Galls very irregular, usually elongated and knot-like (occasionally globoid) telia wedge-shaped, chestnut-brown..... *Sabina scopulorum* { *G. Betheli* Kern. (Bull. Torrey Club 34: 461. 1907.)

Telia appearing on gradual swellings of the branches.

Telia terete.

Telia stout, brownish yellow, spores 2-celled..... { *Juniperus communis* / *Juniperus sibirica* } { *G. clavariaeforme* (Jacq.) DC. (Fl. Fr. 2: 217. 1805.)

Telia slender, orange-yellow, spores 2–5-celled..... { *Chamaecyparis thyoides* } { *G. Ellisii* (Berk.) Farl (Ellis, N. Am. Fungi 271. 1879.)

Telia cristiform, orange-yellow, spores 2–3-celled..... { *Sabina utahensis* / *Sabina monosperma* / *Sabina pachyphlaea* } *G. speciosum* Peck. (Bot. Gaz. 3: 217. 1879.)

Telia hemispherical or applanate.

Telia chocolate-brown, spores 2-celled, pedicels terete..... *Juniperus sibirica* { *G. juniperinum* (L.) Mart. (Fl. Crypt. Erlang. 333. 1817.)

Telia orange-brown, spores 2-celled, pedicels cariotiform..... { *Sabina virginiana* / *Juniperus communis* / *Juniperus sibirica* } *G. germinale* (Schwein.) Kern.

Telia reddish brown, spores 2-celled, pedicels terete..... *Sabina virginiana* { *G. Nidus-avis* Thaxt. (Bull. Conn. Exper. Sta. 107: 3. 1891).

Telia chestnut-brown, spores 2-4-celled, pedicels terete..... { *Chamaecyparis thyoides* } *G. Botryapites* (Schwein.) Kern.

Telia appearing on the young branches or leaves, with no, or only slight, enlargements.

Telia usually causing fasciation of the branches.

Telia reddish brown, spores 2-celled, pedicels terete.....*Sabina virgin ana* { *G. Nidus-avis* Thaxt. (Bull. Conn. Exper. Sta. 107 : 3. 1891.)

Telia cinnamon-brown, spores 2-celled, pedicels terete..... { *Sabina scopulorum* / *Sabina pachyphlaea* / *Sabina virginiana* } *G. Nelsoni* Arth. (Bull. Torrey Club 28 : 665. 1901.)

Telia orange-yellow, spores 2–5-celled, pedicels terete { *Chamaecyparis thyoides* } *G. Ellisii* (Berk.) Farl. (Ellis, N. Am. Fungi 271. 1879.)

Telia chiefly on the leaves or green stems

Telia hemispherical, chocolate-brown, spores 2-celled.....*Juniperus sibirica*.....*G. Davisii* Kern.

Telia tongue-shaped, chestnut-brown, spores 2-celled..... { *Sabina virginiana* / *Sabina sabinoides* } *G. exiguum* Kern.

Telia pulvinate, reddish brown

Teliospores 2–5-celled, pedicels terete.....*Libocedrus decurrens*...*G. Libocedri* (Henn.) Kern.

Teliospores 2-celled, pedicels carotiform.....*Sabina utahensis* { *G. inconspicuum* Kern. (Bull. Torr. Club. 34 : 463. 1907.)

PURDUE UNIVERSITY,
LAFAYETTE,
INDIANA.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1908)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

This Index is reprinted monthly on cards, and furnished in this form to subscribers, at the rate of one cent for each card. Selections of cards are not permitted; each subscriber must take all cards published during the term of his subscription. Correspondence relating to the card-issue should be addressed to the Treasurer of the Torrey Botanical Club.

Atkinson, G. F. On the identity of *Polyporus applanatus* of Europe and America. Ann. Myc. **6**: 179–191. *pl. 2–4.* 31 Jl 1908.

Blanchard, W. H. On the identity of *Rubus canadensis.* Rhodora **10**: 117–121. 15 Au 1908.

Brandegee, T. S. Plants of Sinaloa. Zoe **5**: 243, 244. 5 Mr 1908.

Brandegee, T. S. New species of Mexican plants. Zoe **5**: 244–258. 5 Mr 1908; 259–262. 20 Ap 1908.

Many new species described.

Clute, W. N. On changes in function in dimorphic fronds. Fern Bull. **16**: 65–68. [S] 1908. [Illust.]

Clute, W. N. The check-list of North American fernworts. Fern Bull. **16**: 16–23. [Mr]; 51–57 [Je]; 81–83. [S] 1908.

Cockerell, T. D. A. Species and varieties. Torreya **8**: 194–197. 1 S 1908.

Collins, F. S. The genus *Pilinia.* Rhodora **10**: 122–127. *pl. 77.* 15 Au 1908.

P. Lunatiae and *P. Morsei* spp. nov.

Collins, F. S. Two new species of *Acrochaetium.* Rhodora **10**: 133–135. 10 S 1908.

A. minimum and *A. Hoytii* spp. nov.

Dachnowski, A. The toxic property of bog water and bog soil. Bot. Gaz. **46**: 130–146. *f. 1–6.* 22 Au 1908.

Drummond, J. R. *Agave Watsoni.* Curt. Bot. Mag. **4**: *pl. 8214.* S 1908.

Eaton, A. A. A question of nomenclature. Fern Bull. **16**: 77–79. [S] 1908.

Edwards, A. M. The upper Neocene deposit of Bacillaria around Boston, Massachusetts. Nuova Notar. **19**: 134–137. Jl 1908.

Evans, A. W. New West Indian Lejeuneae. Bull. Torrey Club **35**: 371–389. *pl. 26–28.* 26 Au 1908.
6 new species and the new genus *Leiolejeunea* described.

Fernald, M. L. Note on Michaux's *Vaccinium myrtilloides.* Rhodora **10**: 147, 148. 10 S 1908.

Fernald, M. L. *Draba aurea* in Rimouski County, Quebec. Rhodora **10**: 148. 10 S 1908.

Fernald, M. L. Preliminary lists of New England plants—XXI. *Cyperaceae.* Rhodora **10**: 135–144. 10 S 1908.

Fletcher, E. F. *Achillea tomentosa* at Westford, Massachusetts. Rhodora **10**: 127. 15 Au 1908.

Foxworthy, F. W. Lumbayao (*Tarrietia javanica* Blume). Philipp. Jour. Sci. **3**: 171–173. *pl. 1–3.* Jl 1908.

[Fredholm, A.] Studies on the pollination processes in *Clitoria arborescens* Ait. Bull. Misc. Inf. Trinidad **58**: 79–84. Ap 1908.

Freeman, G. F. A method for the quantitative determination of transpiration in plants. Bot. Gaz. **46**: 118–129. *f. 1.* 22 Au 1908.

[Gibson, H. H.] American trees—77. Balm of Gilead, *Populus balsamifera* Linn. Hardwood Record **26**: 18, 19. 25 Au 1908. [Illust.]

Greene, F. C. Ferns of Bloomington, Indiana. Fern Bull. **16**: 68, 69. [S] 1908.

Grignan, G. T. *Columnea magnifica.* Rév. Hort. **80**: 376, 377. 16 Au 1908. [Illust.]

Guillaumin, A. Répartition géographique et biologie des Burséracées. Rév. Gén. Bot. **20**: 321–327. *pl. 11–14.* 15 Au 1908.

Gürke, M. *Cereus Pringlei* Wats. Monats. Kakteenk. **18**: 121, 122. 15 Au 1908. [Illust.]

Hall, H. M. Studies on California plants—II. Zoe **5**: 263–266. Ap 1908.

Harper, R. M. Some neglected aspects of the campaign against swamps. Southern Woodlands **2**: 46–67. Au 1908.

Harrison, A. K., *and others.* Reports on the flora of the Boston district—III. Rhodora **10**: 128–131. 15 Au 1908.

Harvey, L. H. Floral succession in the prairie-grass formation of southeastern South Dakota. Bot. Gaz. **46**: 81–108. *f. 1–3.* 22 Au 1908.

Howe, M. A. The collection of algae. Jour. N. Y. Bot. Gard. **9**: 123–130. *pl. 46 + f. 17–21.* Jl 1908.

Hutchinson, J. *Rhododendron kamtschaticum.* Curt. Bot. Mag. **4**: *pl. 8210.* Au 1908.

Hutchinson, J. *Robinia Kelseyi.* Curt. Bot. Mag. **4**: *pl. 8213.* S 1908.

Jewell, H. W. *Polypodium vulgare auritum.* Fern Bull. **16**: 85, 86. [S] 1908.

Jones, M. E. Fern genera. Fern Bull. **16**: 88. [S] 1908.

Lurvey, S. A. A new station for *Hieracium pratense.* Rhodora **10**: 148. 10 S 1908.

Merrill, E. D. The Philippine plants collected by the Wilkes United States exploring expedition. Philipp. Jour. Sci. **3**: 73–85. *pl. 1–4.* Je 1908.

Merrill, E. D., & Rolfe, R. A. Notes on Philippine botany. Philipp. Jour. Sci. **3**: 95–127. Jl 1908.

Moody, E. M. *Filipendula rubra* in Maine. Rhodora **10**: 144. 10 S 1908.

Morse, W. J. Observation upon a yellows disease of the fall dandelion. Science II. **28**: 348, 349. 11 S 1908.

Murrill, W. A. Additional Philippine *Polyporaceae.* Bull. Torrey Club **35**: 391–416. 26 Au 1908.
Includes many new species and the new genus *Whitfordia.*

Murrill, W. A. Collecting fungi at Biltmore. Jour. N. Y. Bot. Gard. **9**: 135–141. Au 1908.

Nash, G. V. An unusual specimen of the "Flor de San Sebastian." Jour. N. Y. Bot. Gard. **9**: 130–132. Jl 1908. [Illust.]

Newcombe, F. C. Gravitation sensitiveness not confined to apex of root. Beih. Bot. Centr. **24**: 96–110. *pl. 3 + f. 1–6.* 29 Au 1908.

Orcutt, C. R. Coniferous trees and shrubbery of San Diego County. West Am. Sci. **17**: 4–8. Au 1908.

Parlin, J. C. Some Maine addenda. Rhodora **10**: 146. 10 S 1908.

Parish, S. B. The flowers of *Washingtonia*. Bot. Gaz. **46**: 144–147. *f. 1–5*. 22 Au 1908.

Peirce, M. F. Note on *Weigela rosea*. Rhodora **10**: 131, 132. 15 Au 1908.

Quehl, L. *Mamillaria ramosissima* Quehl n. sp. Monats. Kakteenk. **18**: 127. 15 Au 1908. [Illust.]

Ramaley, F. The botanical gardens of Ceylon. Pop. Sci. Mo. **73**: 193–206. *f. 1–9*. S 1908.

Rand, E. L. Additions to the plants of Mount Desert Island. Rhodora **10**: 145. 10 S 1908.

Reed, H. S. Modern and early work upon the question of root excretions. Pop. Sci. Mo. **73**: 257–266. S 1908.

Robinson, W. J. A study of the digestive power of *Sarracenia purpurea*. Torreya **8**: 181–194. *f. 1*. 1 S 1908.

Scoullar, A. E. Fruiting of *Botrychium*. Fern Bull. **16**: 84, 85. [S] 1908.

Shaw, E. L. A new station for *Iris Hookeri* in Maine. Rhodora **10**: 145, 146. 10 S 1908.

Smith, J. D. Undescribed plants from Guatemala and other Central American republics. — XXX. Bot. Gaz. **46**: 109–117. 22 Au 1908.

16 species in 12 genera described as new.

Stapf, O. *Eucryphia cordifolia*. Curt. Bot. Mag. **4**: *pl. 8209*. Au 1908.

Taylor, N. A collection of vines. Jour. N. Y. Bot. Gard. **9**: 142–144. Au 1908.

Udden, J. A. A cycad from the upper Cretaceous in Maverick County, Texas. Science II. **28**: 159, 160. 31 Jl 1908.

Ulbrich, E. *Malvaceae* austro-americanae imprimis andinae. Bot. Jahrb. **42**: 104–124. 28 Jl 1908.

Many new species described.

Urban, I. Plantae novae andinae imprimis Weberbauerianae—IV. Bot. Jahrb. **42**: 49–176. 28 Jl 1908.

Consists of 18 separate papers here indexed separately under their respective authors: Brand, Chodat, Cogniaux (2), Gilg, Harms (3), von Hayek, Heimerl, Keller, Lindau (2), Pilger, Schneider (2), Sprague, and Ulbrich.

Wilbert, M. I. Some early botanical and herb gardens. Am. Jour. Pharm. **80**: 412–427. S 1908.

THE BRYOLOGIST

WITH THE JANUARY, 1908, NUMBER BEGINS ITS

ELEVENTH YEAR AND VOLUME

It is a 16–20 page bi-monthly devoted to the study of the Mosses, Hepatics, and Lichens. It is fully illustrated with new, original, and artistic drawings and half-tones. It is indispensable to the working bryologist, professional as well as amateur. Send for sample copy. Subscription price $1.00 a year.

Address, MRS. ANNIE MORRILL SMITH, 78 Orange Street, Brooklyn, N. Y.

INDEX TO AMERICAN BOTANICAL LITERATURE

This Index, printed each month in the BULLETIN, is reissued on library catalogue cards; these are furnished to subscribers at the rate of one cent for each card.

Subscriptions to the card-issue may be addressed to the Treasurer of the Torrey Botanical Club,

WILLIAM MANSFIELD, COLLEGE OF PHARMACY, 115 W. 68th St., N. Y. City.

Beginning with January, 1903, the Index has also been reprinted on paper, on one side only, and can be furnished in that form at the rate of $3.00 a year.

North American Flora

THIS work is designed to present descriptions of all plants growing independently of cultivation, in North America, here taken to include Greenland, Central America, the Republic of Panama, and the West Indies, except Trinidad, Tobago, and Curaçao and other islands off the north coast of Venezula, whose flora is essentially South American.

It will be published in parts at irregular intervals by the New York Botanical Garden through the aid of the income of the David Lydig Fund bequeathed by Charles P. Daly.

It is planned to issue parts as rapidly as they can be prepared, the extent of the work making it possible to commence publication at any number of points. The completed work will form a series of volumes with the following sequence:

Volume 1. Mycetozoa, Schizophyta, Diatomaceae.
Volume 2 to 10. Fungi.
Volumes 11 to 13. Algae.
Volumes 14 and 15. Bryophyta.
Volume 16. Pteridophyta and Gymnospermae.
Volumes 17 to 19. Monocotyledones.
Volumes 20 to 30. Dicotyledones.

The preparation of the work has been referred by the Scientific Directors of the Garden to a committee consisting of Dr. N. L. Britton, Dr. W. A. Murrill and Dr. J. H. Barnhart.

Professor George F. Atkinson, of Cornell University, Professors Charles R. Barnes and John M. Coulter, of the University of Chicago, Mr. Frederick V. Coville, of the United States Department of Agriculture, Professor Edward L. Greene, of the United States National Museum, Professor Byron D. Halsted, of Rutgers College, and Professor William Trelease, of the Missouri Botanical Garden, have consented to act as an advisory committee.

Vol. 7, Part 1, Ustilaginales, including Ustilaginaceae and Tilletiaceae, by G. P. Clinton, was issued Oct. 4, 1906. Vol. 7, Part 2, Coleosporiaceae, Uredinaceae, and Aecidiaceae (pars), of the Uredinales, by J. C. Arthur, was issued March 6, 1907. Vol. 9, Parts 1 and 2, Polyporaceae, by W. A. Murrill, were issued Dec. 19, 1907, and March 12, 1908. Vol. 22, Part 1, including Podostemonaceae by George V. Nash, Crassulaceae by N. L. Britton and J. N. Rose, and Penthoraceae and Parnassiaceae by P. A. Rydberg, was issued May 22, 1905. Vol. 22, Part 2, including Saxifragaceae and Hydrangeaceae by J. K. Small and P. A. Rydberg, Cunoniaceae, Iteaceae, and Hamamelidaceae by N. L. Britton, Pterostemonaceae by J. K. Small, Altingiaceae by Percy Wilson, and Phyllonomaceae by H. H. Rusby, was issued Dec. 18, 1905. Vol. 22, Part 3, Grossulariaceae by F. V. Coville and N. L. Britton, Platanaceae by H. A. Gleason, Crossosomataceae by J. K. Small, Connaraceae by N. L. Britton, Calycanthaceae by C. L. Pollard, and Rosaceae (pars) by P. A. Rydberg, was issued June 12, 1908. Vol. 25, Part 1, including Geraniaceae by L. T. Hanks and J. K. Small, Oxalidaceae and Linaceae by J. K. Small, and Erythroxylaceae by N. L. Britton, was issued Aug. 24, 1907.

The subscription price is fixed at $1.50 for each part; it is expected that four or five parts will be required for each volume. A limited number of separate parts will be sold at $2.00 each. Address

THE NEW YORK BOTANICAL GARDEN
BRONX PARK, NEW YORK CITY

PUBLICATIONS BY OFFICERS AND STUDENTS OF THE DEPARTMENT OF BOTANY, COLUMBIA UNIVERSITY

1. MEMOIRS OF THE DEPARTMENT:

Vol. 1. A Monograph of the North American Species of the Genus *Polygonum* (1895). By John Kunkel Small, Fellow in Botany, 1893–1895; Curator of the Herbarium, 1895–1898.

Quarto, 178 pages, 84 plates. Price $6.00.

Vol. 2. A Monograph of the North American Potentilleae (1898). By Per Axel Rydberg, Fellow in Botany, 1896–7.

Quarto, 224 pages, 112 plates. Price $6.00.

2. CONTRIBUTIONS FROM THE DEPARTMENT:

Vol. 1. Nos. 1–25. 1886–1892. Price $5.00.
Vol. 2. Nos. 26–50. 1892–1894. Price $5.00.
Vol. 3. Nos. 51–75. 1894–1895. Price $5.00.
Vol. 4. Nos. 76–100. 1895–1896. Price $5.00.
Vol. 5. Nos. 101–125. 1896–1897. Price $5.00.
Vol. 6. Nos. 126–150. 1897–1898. Price $5.00.
Vol. 7. Nos. 151–175. 1898–1901. Price $5.00.
Vol. 8. Nos. 176–200. 1901–1902. Price $5.00.
Vol. 9. Nos. 201–. 1903–(current).

List of separate numbers available on application.

3. A Text-book of General Lichenology (1896). By Albert Schneider, Fellow in Botany, 1895–1896.

Octavo, 230 pages, 76 plates. Price $4.25 (cloth); $3.80 (paper). Published by Willard N. Clute & Co. Binghamton, N. Y.

The Department invites propositions relative to exchanges of herbarium material for any of the above named publications. Address Dr. Carlton C. Curtis, Columbia University, N. Y. City.

4. An Illustrated Flora of the Northern United States, Canada, and the British Possessions from Newfoundland to the Parallel of the Southern Boundary of Virginia, and from the Atlantic Ocean westward to the 102d Meridian (1896–1898). By Nathaniel Lord Britton, Professor of Botany, 1891–1896; Emeritus Professor 1896–, and Hon. Addison Brown.

Three volumes, royal octavo. Vol. 1, 612 pages; Vol. 2, 642 pages; Vol. 3, 588 pages; 4162 figures in the text, illustrating every species described.

Published by Charles Scribner's Sons, New York. Price, in cloth, $9.00 for the three volumes; with the indexes and keys bound separately, $10.00.

5. Our Native Ferns and their Allies. (Sixth Edition) 1900. By Lucien Marcus Underwood, Professor of Botany, 1896–1907.

Duodecimo, 158 pages, 35 figures. Published by Henry Holt & Co., New York. Price, $1.00.

6. Moulds, Mildews, and Mushrooms. By Lucien Marcus Underwood, Professor of Botany, 1896–1907.

Duodecimo, 236 pages, 10 plates. Published by Henry Holt & Co. Price $1.50.

7. Nature and Development of Plants (1907). By Carlton Clarence Curtis, Assistant in Botany, 1892–1895; Tutor in Botany, 1895–1906; Instructor in Botany, 1906–.

Octavo, 471 pages; 342 illustrations. Published by Henry Holt & Co., New York. Price $2.50.

ESTABLISHED 1851

EIMER & AMEND

205–211 Third Ave., Corner 18th Street NEW YORK

MANUFACTURERS AND IMPORTERS OF

Chemicals and Chemical Apparatus

Our Specialties

MICROSCOPES and ACCESSORIES

MICROTOMES

BALANCES and WEIGHTS

Sole Agents for

C. A. F. KAHLBAUM'S C. P. Chemicals and Reagents

CARL SCHLEICHER & SCHÜLL'S C. P. Filters

SCHOTT & GENOSSEN'S Famous Laboratory Glassware

And for many other renowned European houses in our line.

COMPLETE LINE OF

Bacteriological Apparatus

WE HANDLE

EVERYTHING NEEDED FOR A LABORATORY

Inspection of premises cordially invited.

MEMOIRS OF THE TORREY BOTANICAL CLUB

A series of technical papers on botanical subjects, published at irregular intervals. Price $3.00 a volume. Not offered in exchange.

Vol. 1, No. 1; not furnished separately:

Bailey, Liberty Hyde. Studies of the types of various species of the genus *Carex*. Pages 1–85. 25 My 1889.

Vol. 1, No. 2; not furnished separately:

Martindale, Isaac Comly. Marine algae of the New Jersey coast and adjacent waters of Staten Island. Pages 87–111. 24 Au 1889.

Vol. 1, No. 3; price, 75 cents:

Spruce, Richard. *Hepaticae* Bolivianae, in Andibus Boliviae orientalis, annis 1885–6, a cl. H. H. Rusby lectae. Pages 113–140. 20 Ja 1890.

Vol. 1, No. 4; price, 75 cents:

Sturtevant, Edward Lewis. On seedless fruits. Pages 141–187. 30 My 1890.

Vol. 2, No. 1; not furnished separately:

Halsted, Byron David. Reserve food-materials in buds and surrounding parts. Pages 1–26, *plates 1, 2*. 10 S 1890.

Vol. 2, No. 2; price, 75 cents:

Vail, Anna Murray, & Hollick, Charles Arthur. Contributions to the botany of Virginia. Pages 27–56, *plates 3, 4*. 23 D 1890.

Vol. 2, No. 3; not furnished separately:

Holm, Herman Theodor. Contributions to the knowledge of the germination of some North American plants. Pages 57–108, *plates 5–19*. 15 Ap 1891.

Vol. 2, No. 4; price, 75 cents:

Wheelock, William Efner. The genus *Polygala* in North America. Pages 109–152. 30 D 1891.

Vol. 3, No 1; not furnished separately:

Small, John Kunkel, & Heller, Amos Arthur. Flora of western North Carolina and contiguous territory. Pages 1–39. 20 F 1892.

Vol 3, No. 2; price, $2.00:

Morong, Thomas. The *Naiadaceae* of North America [with illustrations of all the species]. Pages 1–65, *plates 20–74*. 15 Mr 1893.

Vol. 3, No. 3; not furnished separately:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. [Part 1.] Pages 1–67. 28 Ap 1893.

Vol. 4, No. 1; not furnished separately:

Underwood, Lucien Marcus. Index *Hepaticarum*. Part I, Bibliography. Pages 1–91. 10 Je 1893.

Vol. 4, No. 2; not furnished separately:

Small, John Kunkel, & Vail, Anna Murray. Report on the botanical exploration of southwestern Virginia during the season of 1892. Pages 93–201, *plates 75–82*. 18 N 1893–17 Ap 1894.

Vol. 4, No. 3; price, 50 cents:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 2. Pages 203–274. 10 Mr–17 Ap 1895.

Vol. 4, No. 4; price, 50 cents:

Pettit, Anna Stockton. *Arachis hypogaea* L. Pages 275–296, *plates 33–35* 5 Je 1895.

Vol. 4, No. 5; price, 75 cents:

Rydberg, Per Axel. The North American species of *Physalis* and related genera. Pages 297–374. 15 S 1896

Vol. 5; price, $3.00:

List of *Pteridophyta* and *Spermatophyta* growing without cultivation in northeastern North America. Pages 1–377. 4 D 1893–31 D 1894.

Vol. 6, No. 1; price, $1.25:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 3. Pages 1–130. 17 N 1896.

Vol. 6, No. 2; not furnished separately:

Grout, Abel Joel. A revision of the North American *Isotheciaceae* and *Brachythecia*. Pages 131–210. 30 Jl 1897.

Vol. 6, No. 3; price, 50 cents:

Hazen, Tracy Elliot. The life history of *Sphaerella lacustris* (*Haematococcus pluvialis*). Pages 211–246, *plates 86, 87* (*colored*). 8 Je 1899.

Vol. 6, No. 4; price, 50 cents:

Underwood, Lucien Marcus. A review of the genera of ferns proposed prior to 1832. Pages 247–283. 1 D 1899.

Vol. 6, No. 5; price, 25 cents:

Fink, Bruce. Notes on lichen distribution in the upper Mississippi Valley. Pages 285–307. 1 D 1899.

Vol. 7; price, $3.00:

Howe, Marshall Avery. The *Hepaticae* and *Anthocerotes* of California. Pages 1–208, *plates 88–122*. 5 Au 1899.

Vol. 8, No. 1; not furnished separately:

Lloyd, Francis Ernest. The comparative embryology of the *Rubiaceae*. Part I. Pages 1–26, *plates 1–4*. 26 Au 1899. Part II. Pages 27–112, *plates 5–15*. 15 F 1902.

Vol. 8, No. 2; price, $1.00:

Evans, Alexander William. The *Lejeuneae* of the United States and Canada. Pages 113–183, *plates 16–22*. 15 F 1902.

Vol. 8, No. 3; price, 75 cents:

Britton, Elizabeth Gertrude, & Taylor, Alexandrina. The life history of *Vittaria lineata*. Pages 185–211, *plates 23–31*. 30 Au 1902.

Vol. 9; price, $3.00:

Salmon, Ernest Stanley. A monograph of the *Erysiphaceae*. Pages 1–292, *plates 1–9*. 4 O 1900.

Vol. 10; price, $3.00:

Burgess, Edward Sandford. History of Pre-Clusian botany in its relation to *Aster*. Pages i–xii, 1–447. 22 N 1902.

Vol. 11, No. 1; price, $1.75:

Griffiths, David. The North American *Sordariaceae*. Pages 1–134, *plates 1–19*. 30 My 1901.

Vol. 11, No. 2; price, $1.75:

Hazen, Tracy Elliot. The *Ulothricaceae* and *Chaetopheraceae* of the United States. Pages 135–250, *plates 20–42*. 20 O 1902.

Vol. 12, No. 1; price, $1.50:

Northrop, Alice Rich. Flora of New Providence and Andros (Bahama Islands). Pages 1–98, *plates 1–19 + map*. 10 D 1902.

Vol. 12, No. 2; price, $1.00:

Banker, Howard James. A contribution to a revision of the North American *Hydnaceae*. Pages 99–194. 13 Je 1906.

Vol. 12, No. 3; price, 75 cents:

Kupfer, Elsie. Studies in plant regeneration. Pages 195–241. 10 Je 1907.

Vol. 13; price, $3.00:

Burgess, Edward Sandford. Species and variations of Biotian Asters, with discussion of variability in *Aster*. Pages i–xv, 1–419, *plates 1–13*. 15 Mr 1906.

Vol. 14, No. 1; price, $1.25:

Burlingham, Gertrude Simmons. A study of the *Lactariae* of the United States. Pages 1–109, *figures 1–15*. 26 My 1908.

Address: **TORREY BOTANICAL CLUB,**
Columbia University, New York City.

VOL. 35 NOVEMBER, 1908 NO. 11

BULLETIN

OF THE

TORREY BOTANICAL CLUB

Editor

MARSHALL AVERY HOWE

Associate Editors

JOHN HENDLEY BARNHART
JEAN BROADHURST
PHILIP DOWELL
ALEXANDER WILLIAM EVANS
TRACY ELLIOT HAZEN
WILLIAM ALPHONSO MURRILL
CHARLES LOUIS POLLARD
HERBERT MAULE RICHARDS

CONTENTS

The Boleti of the Frost herbarium. (Plates 36-40) . WILLIAM A. MURRILL 517
Some North Dakota Hypocreales . . . . . FRANK J. SEAVER 527
Notes on Rosaceae — I . . . . . PER AXEL RYDBERG 535
Studies in North American Peronosporales — IV. Host index. GUY WEST WILSON 543
INDEX TO AMERICAN BOTANICAL LITERATURE. 555

PUBLISHED FOR THE CLUB

THE NEW ERA PRINTING COMPANY
LANCASTER, PA.

THE TORREY BOTANICAL CLUB

President,

HENRY H. RUSBY, M.D.

Vice-Presidents,

EDWARD S. BURGESS, PH.D. JOHN HENDLEY BARNHART, A.M., M.D.

Recording Secretary,

C. STUART GAGER, PH.D.

Botanical Garden, Bronx Park, New York City.

Treasurer,

WILLIAM MANSFIELD, PHAR.D.

College of Pharmacy,

115 West 68th St., New York City.

MEETINGS

Meetings twice each month from October to May inclusive: the second Tuesday, at 8:00 P.M., at the American Museum of Natural History; the last Wednesday, at 3:30 P.M., in the Museum Building of the New York Botanical Garden.

PUBLICATIONS

All subscriptions and other business communications relating to the publications of the Club should be addressed to the Treasurer, William Mansfield, College of Pharmacy, 115 West 68th St., New York City.

Bulletin. Monthly, established 1870. Price, $3.00 a year; single numbers 30 cents. Of former volumes, only 24–34 can be supplied separately; certain numbers of other volumes are available, but the entire stock of some numbers has been reserved for the completion of sets. Manuscripts intended for publication in the BULLETIN should be addressed to Marshall A. Howe, Editor, New York Botanical Garden, Bronx Park, New York City.

Torreya. Monthly, established 1901. Price, $1.00 a year. Manuscripts intended for publication in TORREYA should be addressed to Jean Broadhurst, Editor, Teachers College, Columbia University, New York City.

Memoirs. Occasional, established 1889. (See last pages of cover.)

Preliminary Catalogue of Anthophyta and Pteridophyta within 100 miles of New York City, 1888. Price, $1.00.

Vol. 35 No 11

BULLETIN

OF THE

TORREY BOTANICAL CLUB

NOVEMBER, 1908

The Boleti of the Frost herbarium

WILLIAM A. MURRILL

(WITH PLATES 36–40)

A brief account of the life and botanical work of C. C. Frost was published in the August number of Torreya, and the reader is referred to that account as a general introduction to the present more critical paper, which was made possible by the recent generous loan of the Frost collection of Boleti by the University of Vermont.

This collection is very rich in type material, containing practically all of Frost's published species and a number of species still in manuscript, which I have treated separately. A number of sheets of type specimens, or type duplicates, twenty or more, were sent to C. H. Peck at Albany, where they are still well preserved. Peck never saw Frost, nor the remainder of his herbarium. He began work near the close of Frost's active life, but his advantages appear to have been greater, and we find Frost turning to him in 1874 for certain determinations and for assistance with the Amherst Catalogue.

There are a number of references in Frost's notes and descriptions to the opinions of Peck regarding various species. There are also four type specimens, or co-types, in the collection, which were sent him by Peck, namely, *B. ampliporus* Peck, *B. gracilis* Peck, *B. elbensis* Peck, and *B. palustcr* Peck, but these are now, unfortunately, in very poor condition.

Frost kept a separate list of spore measurements of the Boleti; he was not particular about spore coloration. I have made a careful examination of his types microscopically and find his figures usually correct.

[The BULLETIN for October, 1908 (35 : 471–516) was issued 3 N 1908.]

The following commentary represents my present views regarding Frost's published and unpublished species. In connection with the latter, I have purposely avoided the publication of anything that would suggest a description, although Frost's diagnoses are in most cases quite complete.

PUBLISHED SPECIES

BOLETUS ALBUS Peck.

Represented by three fine plants. The species is only an albino form of *B. granulatus*.

BOLETUS ALVEOLATUS B. & C.

There are no specimens bearing this name in the Frost herbarium. An excellent description, however, of this species was published in the Catalogue of Boleti of New England.

BOLETUS AURIPORUS Peck.

Seven good specimens are found under this name, which Frost always spelled with an extra "*s*" (*aurisporus*), probably because the spores as well as the tubes are yellow. These specimens, now about forty years old, have retained the yellow color in their tubes to a remarkable extent.

BOLETUS BICOLOR Peck.

Represented by eight faded and moulded plants.

BOLETUS BOVINUS L.

Represented by eight fair to poor, more or less moulded, specimens, which may be referred almost certainly to *B. granulatus*.

BOLETUS CASTANEUS Bull.

There are two sheets in the collection, one containing five specimens and the other six, all well preserved.

BOLETUS CHROMAPES Frost.

Represented by seven good plants.

BOLETUS CHRYSENTERON Fries.

Three faded plants represent this very common species.

BOLETUS COLLINITUS Fries.

One sheet contains three very poor plants collected in pine woods in autumn. The other sheet, containing five good specimens, was first labeled "*B. granulatus*" and later changed to *B. collinitus*. The first determination was correct for both sheets.

BOLETUS CYANESCENS Bull.

Six good plants are preserved. Frost has marked it "rare."

BOLETUS DECORUS Frost.

Represented by three good specimens, which may be referred to *B. edulis*.

BOLETUS EDULIS Bull.

One sheet contains two poor plants with their stems eaten away by insects. On the other sheet is one very poor specimen, which may be *B. edulis*, and a fine plant that is certainly *B. ornatipes*. In a letter to Professor Peck, dated Nov. 27, 1874, Frost says: "Have you Curtis' full description of *Boletus retipes*? From all I can gather it seems to me that the specimen I sent you as such is the true one. What you describe as such I suspect is a variety of *B. edulis*, it indeed does it exactly. If Bulliard's figure is the true species, then Sowerby's must be a variety, for they are very much unlike in appearance but microscopically they are the same species. What you describe is abundant here. Unless I greatly mistake, it is another variety of *Boletus edulis*. I am familiar with all three of them."

BOLETUS ELEGANS Schum.

This name is doubtfully assigned by Frost to a specimen from Sprague and to one collected by himself, neither of which is very well preserved. The former is *B. luteus* and the latter is possibly *B. Ravenelii*.

BOLETUS FELLEUS Bull.

One sheet contains a single large plant cut in half. It is well preserved. The other sheet contains five plants, four of them apparently *B. ornatipes*, and a single one, in the lower corner on the right, *B. felleus*.

BOLETUS FERRUGINEUS Frost.

There is one sheet under this name containing five excellent specimens collected in 1867 under oak trees near borders of woods. A full description is written at the bottom of the sheet. I cannot distinguish the species from *B. felleus*. (PLATE 36.)

BOLETUS FIRMUS Frost.

Two poor plants represent this species, which is probably not distinct from *B. luridus* Schaeff. In *B. luridus* the stem is usually

punctate, but often reticulate at the top or for some distance downward.

BOLETUS FLAVIDUS Fries.

Most of the specimens appearing under this name in the Frost collection belong to what we know in this country as *B. americanus* Peck. They were collected in pine woods and grassy places, and are mostly very poorly preserved. Twenty specimens are glued to sheets and five are contained in a small paper box. A larger box similarly labeled contains seven good specimens of *B. lutcus.*

BOLETUS FLAVUS With.

Represented by about fifteen moulded specimens in a paper box, which may doubtless be referred to *B. lutcus.*

BOLETUS FROSTII Russell.

Represented by six sheets, containing in all twenty-one good plants and seven in fair condition. Where the habitat is mentioned, it is "borders of woods." The name is written "*B. Frosti*" or "*B. Frostii*" indifferently. The species is not distinct from *B. alveolatus.*

BOLETUS GRANULATUS L.

Two sheets, containing ten specimens in a fair state of preservation, represent this common species.

BOLETUS GRISEUS Frost.

Represented by three sheets containing thirteen good specimens. The species was published by Peck in the 29th Report of the N. Y. State Museum of Natural History. Dried specimens may be easily confused with *B. ornatipes*, but the white color of the tubes readily distinguishes it in the field. Frost's notes refer to *B. griseus* with intensely yellow tubes, which was evidently *B. ornatipes.*

BOLETUS INNIXUS Frost.

Represented by a sheet containing three good plants collected in grassy woods in 1866; also a sheet containing two small poorly preserved specimens united at the base. *B. innixus* is plainly an abnormal or distorted form of *B. auriporus*, representing the maximum of size and irregularity in the tubes and a reclining habit not usual in typical plants. The descriptions are practically identical, and the type specimens of *B. innixus* show the characteristic yellow

color of the tubes of *B. auriporus* still well preserved. The specimens united at the base suggest another synonym, *B. caespitosus* Peck, in which the subcespitose character and the subcuticular reddish tint were emphasized. (PLATE 37.)

BOLETUS LIMATULUS Frost.

This species, reported rare by Frost, was collected in hilly woods in July, 1869. One sheet contains five fair plants, with full description, and another three plants well preserved. They may all be referred to *B. edulis*.

BOLETUS LUTEUS L.

None of the specimens are good, most of them being moulded. There are three sheets containing fourteen plants, one of the sheets having "*B. flavidus*" written on it in pencil.

BOLETUS MAGNISPORUS Frost.

Represented by three sheets containing six poor specimens collected in woods and thickets. The species is not distinct from *B. luridus*. The spores are oblong-elliptical, decidedly ferruginous-fulvous, 12–16 μ × 4–5 μ. Frost makes them 16.5 μ × 6 μ. The color of the spores is probably greenish in fresh specimens.

BOLETUS MINIATO-OLIVACEUS Frost.

Represented by two sheets containing five excellent specimens collected in woods and borders.

BOLETUS ORNATIPES Peck.

Represented by two sheets containing ten good plants. See remarks under *B. edulis*, *B. felleus*, and *B. retipes*.

BOLETUS PALLIDUS Frost.

Represented by three sheets, containing three excellent specimens and six more or less moulded ones. On one sheet is a full description. (PLATE 38.)

BOLETUS PECKII Frost.

This species, published by Peck in the 29th Report, does not appear in the collection.

BOLETUS PICTUS Peck.

See *Boletus Murraii*, in the list of unpublished species.

BOLETUS PIPERATUS Bull.

The collection contains two sheets of this species, one with five poor plants and one with four good ones. The habitat is given as "woods and grass grounds."

BOLETUS RAVENELII B. & C.

There is one sheet with seven excellent specimens, in which even the colors are well preserved. Above "*B. subchromeus* Frost" is written "*B. Ravenelii* B. & C. first by publication."

BOLETUS RETIPES B. & C.

In a copy of his Catalogue presented to Mr. C. G. Pringle in 1876, this name is scratched and replaced by *B. ornatipes*, with the statement that "*B. retipes* is not a good Vermont species." See remarks under *B. edulis*.

BOLETUS ROBUSTUS Frost.

Represented by three good plants collected in 1862 in the borders of shady woods. A full description accompanies the specimens. On account of *Boletus robustus* Fries, described earlier from Costa Rica, Peck assigned a new name, *B. eximius*, to this species.

BOLETUS ROXANAE Frost.

Four fair specimens with full description and an outline sketch appear on one sheet. Another sheet has four good specimens, and still another contains five in fair condition, at least one of which is *B. castaneus*. This same sheet contains also a good specimen of the yellow-stemmed variety of *B. Roxanae*, first reported by Peck as *B. sulfureus* and later changed to var. *auricolor*. *B. multipunctus* Peck is probably not distinct from *B. Roxanae*. (PLATE 39.)

BOLETUS RUBEUS Frost.

Frost found this species in deep woods. There are three sheets, containing eight good plants and four rather poor ones. A study of these various specimens in connection with the description shows the species to be too near *B. bicolor* to be regarded as distinct.

BOLETUS RUSSELLII Frost.

This handsome species is represented by three excellent large plants and five specimens only fairly well preserved. They were collected in moist woods in 1862. (PLATE 40.)

BOLETUS SALMONICOLOR Frost.

Represented by twelve poor specimens collected in the borders of pine woods. This species is apparently synonymous with *B. luteus*.

BOLETUS SATANUS Lenz.

This name appears in an annotated copy of the Amherst Catalogue in Frost's library. It is represented by three sheets, containing seven fair and three poor specimens, none of them distinct from *B. luridus*.

BOLETUS SCABER Bull.

This exceedingly common species is represented by a sheet containing two good plants, and another containing four very poor specimens which are both moulded and eaten by insects. Some of the specimens under *B. versipellis* also probably belong here.

BOLETUS SEROTINUS Frost.

Represented by two sheets containing ten plants rather poorly preserved, collected in 1862 on shady grassy ground late in autumn. The description, habitat, and late habit, as well as the types themselves, point to *B. Clintoniamus*, from which this species can hardly be distinct.

BOLETUS SISTOTREMA Fries.

The single specimen bearing this name is so very poor that it suggests no comment. Frost evidently thought he had what Peck listed under this name in the 23d Report, which proved to be a form of *B. piperatus* with large unequal tubes near the stem.

BOLETUS SORDIDUS Frost.

Represented by four rather good plants collected on recently excavated earth in woods in midsummer.

BOLETUS SPADICEUS Schaeff.

Represented by a dozen fair to good specimens, all of which agree well with *B. subtomentosus*. *B. spadiceus* probably does not occur in America.

BOLETUS SPECIOSUS Frost.

This handsome species is well represented by two fine plants cut in half and excellently preserved. Even the color and surface characters of the stem are well shown.

BOLETUS SPRAGUEI Frost.

Represented by two sheets, containing three mature specimens and a cluster of smaller ones, all well preserved. This species is placed by Professor Peck under his *B. vermiculosus*, which is, in

turn, only a form of *B. luridus*. Even if Frost's species had been distinct, the name could not have been retained on account of *B. Spraguei* B. & C., published two years previously for *B. pictus* Peck.

BOLETUS STROBILACEUS Scop.

This common species is represented by five good plants. Frost later changed the generic name to *Strobilomyces*, in accordance with Berkeley's classification.

BOLETUS SUBTOMENTOSUS L.

Represented by nine rather poor specimens, some of which may be *B. chrysenteron*.

BOLETUS TENUICULUS Frost.

Three poor specimens represent this species, the central one apparently quite distinct from the other two. The description, also, is very brief, leaving the identity of the species in doubt, unless better authentic specimens exist elsewhere.

BOLETUS UNICOLOR Frost.

This species was published by Peck in 1889 from manuscript only. Frost's collection contains a single sheet with five poor plants, which add little to the description.

BOLETUS VERSIPELLIS Fries.

Represented by six good plants and four that are only fair. They may be only a reddish brown form of *B. scaber*.

BOLETUS VIRIDARIUS Frost.

This species, not distinct from *B. Clintonianus*, was collected on grass plats in October and November. It is represented by a sheet with seven poor specimens and a piece of cardboard containing six good ones.

BOLETUS VISCOSUS Frost.

The collection contains twenty-one plants, all rather poor, collected in pine or fir woods in autumn. They are all alike, with very short stem, well deserving the name *B. brevipes*, assigned them by Peck in the 38th Report, although probably only a form of *B. granulatus*. The name *B. viscosus* was untenable, having already been used by Venturi.

UNPUBLISHED SPECIES

BOLETUS AUREOBRUNNEUS Frost.

Two sheets, with three good specimens, represent this species, which is synonymous with *B. ornatipes* Peck.

BOLETUS CANUS Frost.

Represented by two sheets, with three good plants and two poor ones. They are probably *B. edulis*.

BOLETUS DIFFRACTUS Frost.

Represented by two poor plants cut in half and hardly worth studying. It is apparently near *B. bicolor*.

BOLETUS FARLOWI Frost.

Three sheets, containing seven good specimens and two very poor ones, represent this species, which is hardly distinct from *B. edulis*.

BOLETUS FLAVO-AUREUS Frost.

Collected in rich woods in August and September, 1867, and represented by five good plants and six that are only fair. On the type sheet is written, "*B. affinis* Peck by first publication."

BOLETUS GLUTINIPES Frost.

Represented by three good plants collected in moist woods in 1863. On the sheet is a good description, and the words, "*aurisporus* Peck by first publication."

BOLETUS GRAMINICOLA Frost.

Three good specimens, collected on grassy ground in October, represent this species, which can hardly be distinct from *B. Clintonianus*. The specific name first selected by Frost was "*graminis*," which was not in good form, and he soon changed it to "*graminicola*".

BOLETUS INTERRUPTUS Frost.

The collection contains three very poor plants of this species, which would hardly repay study, especially as I find no description

BOLETUS LENTICULARIS Frost.

Represented by fifteen good plants, collected during September and October on excavated earth in woods, accompanied by a full description. I see no distinction between this species and *B. subtomentosus*.

BOLETUS MURRAII Frost.

Represented by three sheets, containing five good plants and one poor one, all of which Frost refers to "*B. pictus* Peck by first publication." The following footnote under *B. pictus* in his Catalogue of Boleti explains the change of name:

"This species was discovered several years since by the late Mr. Dennis Murray, of Roxbury, Mass., and named *Boletus Murraii*, B. & C. (C. J. Sprague's MSS.). Under this name I have distributed it. Recently it has been published in the "Grevillea," a London periodical, as *Boletus Spragueii*, B. & C. Mr. Peck, of the New York Botanical Survey, several months before this latter, published it as *Boletus pictus* Peck; therefore his name has the priority."

BOLETUS PALUDOSUS Frost.

Seven good plants and two small poor ones, all collected in marshy woods, represent this species. Both the specimens and the description point to *B. chrysenteron*, from which it can hardly be distinct.

BOLETUS RUBRIPES Frost.

Two sheets containing four fair to poor specimens collected in pine woods are to be found in the collection. The poor specimens and brief description hardly warrant a guess as to its identity, although there is a resemblance to *B. Peckii* in some of the specimens.

BOLETUS SUBCHROMEUS Frost.

The sheet bearing this name contains seven excellent plants collected in moist woods late in autumn, accompanied by a full description. On another sheet this name was changed to *B. Ravenelii* B.C., already published for this species.

BOLETUS SUBRETICULATUS Frost.

Only one plant is to be found in the collection and this is glued to the sheet with the surface down, and what remains is badly moulded. The description implies a relationship to *B. chrysenteron* or *B. subtomentosus*.

BOLETUS VINACEUS Frost.

Represented by eight poor moulded plants and a full description. Frost refers them to "*B. gracilis* Peck by first publication."

NEW YORK BOTANICAL GARDEN.

Some North Dakota Hypocreales

FRED J. SEAVER

For some time past the writer has been engaged in the preparation of a monograph of the North American Hypocreales and the year spent in North Dakota, in the employ of the North Dakota Agricultural College, afforded a fair opportunity for the study of the various species of this order in that particular locality. While the work on the local fungi of that state was not limited to the order treated here, an especial effort was made to accumulate as much material of this order as possible. All of the species reported here were collected in the summer and autumn of 1907 and the spring of 1908. Most of the material was collected near Fargo, in the extreme eastern part of the state, but several specimens were obtained at Hawk's Nest, a low range of hills near the central part of the state, the ravines of which are shaded by a considerable growth of forest trees.

North Dakota, being essentially a prairie state and having its timbered regions limited to narrow belts along the rivers, lakes, and ravines in mountainous districts, does not afford the most favorable conditions for the growth of those forms of fungi which thrive best in moist shaded places. But notwithstanding the unfavorable conditions, the season spent in work on the fungus flora of this state was rewarded with a surprisingly large number of the saprophytic forms, while parasitic fungi which occur in more open regions were found to be most abundant.

The order Hypocreales is represented by approximately two hundred species in the whole of North America, and it would not be expected that a large number of species of a single order of this size would be collected in a given locality during one season. The list is published at this time, not on account of the large number collected, but to add to the knowledge of the distribution of this order in North America, and since there is little published work on the fungi of North Dakota, it is hoped the list will be of interest to some.

Of the twenty species reported here one at least deserves especial mention. *Nectria tubercullariformis* (Rehm) Winter was collected in the autumn of 1907 on herbaceous stems and one specimen was found in full fruit on the bark of a dead branch. No specimen of this species had previously been seen in the collection of North American Hypocreales examined and up to the present time no record of it from North America has been seen. During the spring of 1908 a quantity of the material was collected on dead stems of nettle, on which host the species has been reported in Europe. The species, while a true stromatic *Nectria*, is specifically very distinct from any of the other forms of the genus that have been examined. The stroma is tubercular, very distinct in outline, and rounded or more often elongated. The perithecia are small and instead of being cespitose on the stroma so as to cover it almost completely, as is usually the case, they are entirely superficial and distributed over its surface, being often scattered but occasionally crowded. The species is of interest not only on account of its distribution but for its peculiar specific characters.

The identification of the species recorded here has been facilitated by access to the collections of the New York Botanical Garden, with its numerous types, as well as by the types that have been received from individuals during the course of the work on the order.

Synopsis of the genera

Perithecia free on the substratum, or entirely superficial on a sessile stroma.

Perithecia dark blue with transmitted light (nearly black to the naked eye), spores with 3 or more septa. — I. GIBBERELLA.

Perithecia normally bright colored, of some shade of red, yellow, or brown (often becoming dark with age).

Spores 2-celled. — II. NECTRIA.

Spores muriform. — III. PLEONECTRIA

Perithecia more or less immersed in a common matrix, varying from a cottony subiculum to a distinct fleshy stroma.

Matrix consisting of a cottony subiculum in which the perithecia are seated, usually growing on other fungi; spores fusiform. — IV. HYPOMYCES.

Matrix consisting of a distinct fleshy stroma, sessile or erect; spores filiform or subglobose.

Asci 16-spored (by the breaking of each spore into two); spores subglobose; stroma sessile (very rarely erect). — V. HYPOCREA.

Asci 8-spored; spores filiform, nearly as long as the ascus; stroma erect (very rarely subsessile).

Stroma springing from a sclerotium formed in the ovaries of plants. VI. CLAVICEPS.
Stroma springing from the bodies of dead insects, larvae, or underground fungi. VII. CORDYCEPS.

I. GIBBERELLA

GIBBERELLA PULICARIS (Fries) Sacc. Very common on old corn-stalks about Fargo. This fungus is reported to have as its conidial phase species of *Fusarium*. The mature fruit appears on dead materials and its connection with a *Fusarium* suggests a possibility of its association with plant diseases. The life-history of this plant should be more carefully studied.

II. NECTRIA

a. Perithecia solitary and free on substratum.

NECTRIA PEZIZA (Tode) Fries. This is one of the most common of the non-stromatic forms of *Nectria* and occurs on various kinds of dead materials. It is perhaps most common on decayed wood but is often found on old fungi and one very good specimen was collected in North Dakota on a piece of old burlap sacking. The species is characterized by the rather large nearly globose perithecia which collapse when dried so as to resemble a small *Peziza*, for which the species has often been mistaken. The spores also are characteristic, being broadly elliptical and non-constricted. Various collections were made at Fargo and Hawk's Nest.

NECTRIA EPISPHAERIA (Tode) Fries. On various kinds of sphaeriaceous fungi. The species is distinguished from *Nectria sanguinea* Bolton by its occurrence in this kind of a habitat. The forms occurring on fungi show a strong tendency to collapse from the two opposite sides, which tendency, although less common, is not entirely lacking in young specimens of *Nectria sanguinea* Bolton. It is thought doubtful if the two are specifically distinct. Both are characterized by the blood-red color of the perithecia.

b. Perithecia borne on a stroma, often cespitose.

NECTRIA COCCINEA (Pers.) Fries. Several specimens on dead branches in woods near Fargo. The species is distinguished by the scarlet-red perithecia, borne in clusters on a yellowish stroma.

NECTRIA PURPUREA (L.) Wilson & Seaver.

Nectria cinnabarina (Tode) Fries.

On dead branches of various kinds of trees and shrubs. The mature fruit of this plant occurs on dead branches and usually in great abundance, but its conidial phase is reported to be parasitic. The species is recognized by the rough perithecia, which vary in color from rather bright cinnabar-red to dull brownish black and are borne in dense clusters on a tubercular stroma.

NECTRIA VERRUCOSA (Schwein.) Sacc. On dead branches in woods near Fargo. The perithecia and spores of this species are identical with those of the preceding. The species is distinguished by the fact that the stroma is depressed, never rising above the surface of the bark, while in the preceding it is tubercular and very prominent.

NECTRIA TUBERCULARIFORMIS (Rehm) Winter; Rabenh. Krypt. Flora 1^2: 118, 119. 1887.

Hypocrea tuberculariformis Rehm, Ber. Naturh. Ver. Augsburg **26**: 106. 1881.

Exsicc.: Rehm, Ascom. *435, 679.*

Other specimens examined: N. Dakota, *Seaver*, various collections.

Habitat: Herbaceous stems (especially *Urtica* sp.), bark, and dung.

Stroma tubercular, rounded or more usually elongated, nearly smooth or in dried specimens often longitudinally striated, pinkish or rose-colored, becoming dull red with age.

Perithecia superficial, solitary or more or less crowded, small, averaging about 200 μ in diameter, smooth or nearly so, globose with a rather prominent ostiolum, delicately rose-colored, becoming slightly collapsed from above when dry; asci clavate, 8-spored, about 40–50 $\mu \times$ 6–7 μ; spores 1- or 2-seriate, mostly 2-seriate above and 1-seriate below, usually a little broader above, fusoid, and a little constricted at the septum, with two or more small oil-drops in each cell, 8–11 $\mu \times$ 3–4 μ.

The conidial phase is often very abundant but the mature fruit is less common.

III. PLEONECTRIA

PLEONECTRIA BEROLINENSIS Sacc. On dead branches of red currant in the Agricultural College Gardens and also on branches

of wild black currant in woods near Fargo. Very destructive to currants in cultivation. In external appearance the plants of this species very closely resemble those of *Nectria purpurea* (L.) W. & S. but the species is very distinct in the spore characters. The spores instead of being 2-celled are divided both longitudinally and transversely into numerous cells.

IV. HYPOMYCES

HYPOMYCES AURANTIUS (Pers.) Fuckel. On decaying fungi of various kinds. Various collections, Fargo and Hawk's Nest. The fungus presents to the naked eye a rusty red appearance due to the cottony stroma, which spreads over the substratum often for several inches. Closer examination will show the orange-colored perithecia scattered over the stroma. The species is rather common.

HYPOMYCES LACTIFLUORUM (Schwein.) Tul.

Hypomyces purpureus Peck.

On some agaric in woods near Fargo. The stroma of this plant, which entirely covers the hymenium of the host infected, presents an orange-yellow color. Scattered over the orange surface are the perithecia, which are nearly immersed, with necks protruding. As the plants of the host decay, they become purple, which accounts for the specific name of the synonym given above. The species was found to be abundant in one locality.

HYPOMYCES OCHRACEUS (Pers.) Tul. On some agaric in same locality as preceding. The plants differ from the preceding by the fact that the stroma is almost entirely white when fresh, becoming yellowish as it dries. There is also a marked difference in the spores.

HYPOMYCES POLYPORINUS Peck. On old plants of *Coriolus versicolor*, in woods near Fargo. The plants of this species occur on the under surface of the host and would scarcely be seen except by accident or special search. Characterized by the amber color of the perithecia and the habitat as well as by spore characters. Found in considerable abundance. I am indebted to Professor C. H. Peck for an authentic specimen of this species for comparison.

HYPOMYCES ROSELLUS (Albert. & Schwein.) Tul. Several collections on the under side of rotten logs in woods near Fargo.

The species is well marked by the delicate rose color of the subiculum and perithecia as well as by spore characters.

V. HYPOCREA

HYPOCREA CITRINA (Pers.) Fries. On dead limbs of basswood, especially where the outer bark has been removed. Plants form a bright lemon-yellow stroma, often several inches in extent on the substratum. The perithecia are seen as little dots over the surface of the stroma. The plants resemble those of the preceding genus but are readily distinguished by the spore characters. Considerable quantity of this material has been collected but always on the same host.

HYPOCREA PATELLA Peck. The stroma in this species is very small as compared with the preceding and not so bright-colored. In the specimens of this species collected, it seems to show a tendency to grow on old sphaeriaceous fungi. This has been compared with specimens identified by Professor Peck.

HYPOCREA RICHARDSONI Berk. & Mont. Very common on limbs of *Populus tremuloides* in woods near Fargo. No perithecia have been seen in any of the specimens which have been examined. Although in external appearance the plants resemble a *Hypocrea*, it is doubtful if they rightfully belong to this genus.

HYPOCREA RUFA (Pers.) Fries. The specimens which were collected in Fargo were small and not fair examples of this species, but they seem to belong here.

VI. CORDYCEPS

CORDYCEPS MILITARIS (L.) Link.

Isaria farinosa Fries.

On larvae of insects in Fargo woods. Only the conidial phase of this plant was collected in North Dakota but that occurred in considerable abundance and doubtless the mature fruit would have appeared at the proper season. The conidial phase is characterized by the snow-white feather-like growth, with its yellowish stem which springs from larvae that are buried under leaves and soil.

CORDYCEPS PISTILLARIAEFORMIS Berk. & Broome. On scale-insects on branches of *Xanthoxylum americanum* in woods about Fargo. The plants of this species collected do not show mature

asci and spores but otherwise correspond well with other specimens of this species that have been examined.

VII. CLAVICEPS

CLAVICEPS PURPUREA (Fries) Tul. The species was collected by the writer on several hosts including *Bromus*, *Agropyron*, and cultivated rye, in the Agricultural College grounds. The fungus is a parasite and besides causing some reduction in the crop is also the cause of a characteristic disease among cattle. It is used as an official drug under the name of ergot.

NEW YORK BOTANICAL GARDEN.

Notes on Rosaceae—I

PER AXEL RYDBERG

The author has thought it advisable to publish a series of notes on this family, supplementary to his monograph in the North American Flora, vol. 22, beginning on page 239. The reasons for so doing, are:

1. The plan of the North American Flora does not allow many critical notes and explanations, and many facts worthy of presentation must necessarily be omitted on account of lack of space.

2. It is not always evident from the synonymy alone, why a certain name should be adopted in preference to another.

3. It is often desirable to present the author's reasons for his limitation of genera and species.

4. In the North American Flora, only the types of new species are given. It is often desirable to cite some more specimens, which would help in identification of these species, when the types are not accessible.

OPULASTER Medic.

There may be some doubt as to whether this genus was properly published. The original publication consists only of citing *Spiraea opulifolia* L. as a synonym of *Opulaster bullatus* Medic. *Icotorus* Raf., *Epicostorus* Raf., and *Physocarpa* Raf., were published in about the same way. The only name for the genus, which was accompanied by an adequate description, was *Physocarpus* Maxim.; but this, as well as *Physocarpa* Raf., is invalidated by the older *Physocarpon* Necker,* and *Physocarpum* Bercht. & Presl,† which both have Latin diagnoses. Under the latter, there are also two species named and described. There is, therefore, no alternative left but the retaining of *Opulaster* as the name of the genus, unless the making of a new name is preferred.

* Elem. Bot. 2 : 164. 1790.

† Rostl. 1 : Ranunc. 14. 1823.

In the North American Flora, thirteen species of *Opulaster* are admitted. Of these, nine are previously known species, while four are proposed as new. Of the more recently described species, *Physocarpus michiganensis* Daniels, and *P. missouriensis* Daniels, were placed as synonyms under *O. opulifolius* and *O. intermedius*, respectively. The only distinctive character given by Daniels is the pubescence, which is said to consist of stellate hairs in his two new species; while the two older species should have glabrous leaves or pubescent ones with simple hairs. In none of the species of this genus are the hairs normally simple; only occasionally simple hairs are found. While in *O. opulifolius* the leaves are usually glabrous or nearly so, they are in *O. intermedius* usually quite pubescent, and the hairs commonly branched. If the amount of pubescence should be regarded as a distinctive specific character in *Opulaster*, then *Spiraea ribifolia* Nutt., or *Neillia opulifolia multiflora* Durand, should be regarded as a distinct species from *O. capitatus*, and *O. pubescens* Rydb. from *O. malvaceus* (Greene) Kuntze.

Spiraea ribifolia Nutt., the more glabrate form of *O. capitatus*, has often been confused with *O. opulifolius*, and it is this form that has caused the error of including the Pacific coast in the range of *O. opulifolius*, which is confined to the Alleghanian region. The amount of pubescence is indeed of very little value, and the only reliable characters by which to distinguish the eastern species from its western ally are the long caruncle in the former and the different shapes of the leaves, especially those of the sterile shoots.

As stated above, *O. pubescens* Rydb. is reduced to a synonym of *O. malvaceus*. *O. Ramaleyi* A. Nelson is made a synonym of *O. intermedius*, while in my Flora of Colorado it was regarded as the same as *O. bracteatus* Rydb. The first specimen cited by Nelson belongs to *O. bracteatus*, but it does not agree with the description of the carpels. All the other specimens cited agree with said description, and these belong to *O. intermedius*. *O. Ramaleyi* should therefore be regarded as the same as that species.

The four new species described are: *O. australis*, related to *O. opulifolius* and *O. capitatus*; *O. cordatus*, related to *O. intermedius*; *O. alabamensis*, related to *O. stellatus*; and *O. Hapemanii*, related to *O. monogynus*.

O. australis resembles a small *O. opulifolius*, but it has the short caruncle of the western *O. capitatus*. Its carpels are only about half the size of those of either of the two species mentioned. *Spiraea caroliniana*, mentioned in Marshall's Arbustum, may belong here, but that species was evidently never published. To *O. australis* belong, beside the type given, the following specimens:

North Carolina: Craggy Mountain, July 8 and Sept. 8, 1897, *Biltmore Herbarium 1282 b.*

Virginia: Summit, Stony Man Mountain, Aug. 13, 1901, *E. S. & Mrs. Steele 170;* Peaks of Otter, June 6, 1890, *A. Brown, T. Hogg, &c.*

In the herbarium of the New York Botanical Garden there is a specimen, received from the herbarium of P. V. LeRoy, and according to the label collected in Mexico by Vischer, in 1838. This has even smaller flowers than *O. australis*. As *Opulaster* is otherwise unknown from Mexico, there was probably a mistake in labeling or a misplacement of labels, and the specimen probably came from some other place. This specimen was therefore ignored when the manuscript for the North American Flora was prepared.

O. cordatus is most closely related to *O. intermedius*, but the two species differ in the form of the leaves and the ranges of the two are widely separated. Besides those of the type collection, given in the Flora, only the following specimens may be doubtfully referred to it:

California: Portola, July, 1903, *Elmer 4804.*

O. alabamensis is somewhat intermediate between *O. stellatus* and *O. intermedius*, but differs from both in the shape of the leaves, especially those of the sterile shoots. To *O. alabamensis* belong the following specimens:

Alabama: Auburn, Sept., 1900, *Lloyd & Earle;* April 17, 1897, *Earle & Baker;* July 11, 1896, *Earle & Underwood.*

South Carolina: Sandy river bottom, Clemson College, May 20, 1906, *H. D. House 2175;* Six Miles Creek, May 19, 1907, *3383.*

O. Hapemanii might be a hairy form of *O. monogynus*, just as *O. opulifolius*, *O. intermedius*, *O. capitatus*, and *O. malvaceus* have strongly pubescent and almost glabrous forms. *O. Hapemanii* is, however, so unlike *O. monogynus* in habit that it was thought ad-

visable to give it a distinct name. In many respects it resembles strongly *O. alternans*, and the author has entertained the thought that it might be a 2-carpellary form of that species. The styles in *O. Hapemanii* are, however, more or less spreading, while in *O. alternans* the style is erect, showing that the latter is related to *O. malvaceus*. Besides the type, the following specimens may be referred to *O. Hapemanii*:

Wyoming: Hartville, July 20, 1894, *Aven Nelson 498*.

The following specimens are referred to *O. alternans*:

Utah: Provo, Wahsatch Mountains, June 16, 1902, *Goodding 1159*; Stansbury's Island, June 26, 1850, *Stansbury*.

Nevada: East Humboldt Mountains, *S. Watson*.

Mr. A. A. Heller adopted the name *O. pauciflorus* for *O. malvaceus*. It is true that the original specimens of *Spiraea pauciflora* Nutt. belong to this species; but *S. pauciflora* was never properly published, only mentioned as a synonym under *S. opulifolia pauciflora* in Torrey and Gray's Flora. This variety was, however, primarily based on *S. monogyna* Torr., and hence belongs rather to *O. monogynus*.

SPIRAEA

Spiraea parvifolia Benth. is a very strange and interesting species. Maximowicz referred it to the section (now the genus) *Petrophytum*. It is, however, a true *Spiraea*, notwithstanding the racemose inflorescence and the entire leaves. Neither has it the depressed habit nor the fruit of *Petrophytum*. As far as is known to me, it has been collected but once. By the courtesy of the director of the Kew Gardens, England, the New York Botanical Garden has received an excellent drawing of the type and some fragments of the plant, enough to show its real character. Unfortunately, *S. parvifolia* Benth. is antedated by *S. parvifolia* Raf. I therefore took pleasure in naming the plant *S. Hartwegiana*, after the discoverer.

The species which appeared in the North American Flora under the name *S. Steveni* has had a peculiar history. The older botanists referred it to *S. chamaedryfolia* L., a species with the flowers in simple corymbs, instead of in flat-topped panicles. Later, it was referred, together with *S. corymbosa*, *S. lucida*, *S. splendens*,

and *S. densiflora*, to the Siberian *S. betulifolia*. Dr. E. L. Greene apparently was the first one to point out that the Alaskan species differed from all the other North American relatives in having reflexed sepals. As this is a character found in the original *S. betulifolia* he removed from that species all but the Alaskan plant. The latter, however, differs considerably from Pallas's figure of *S. betulifolia*, and also from Siberian specimens of the same in the Torrey Herbarium. After some search among the literature on the genus, I found that the Alaskan plant had been described by C. K. Schneider. That *S. Stevcni* is distinct from *S. betulifolia*, is evident. There may be some doubt, however, whether it is specifically distinct from *S. Beauverdiana* of which Schneider made it a variety. I have seen no specimens of *S. Beauverdiana*, but from the characters given by Schneider, it seems distinct enough.

It is strange that the oldest specific name and publication of the beautiful little shrub of the mountains of California and Oregon, usually known as *S. arbuscula*, should have been overlooked so generally. Only in a single one of the later German works on woody plants is the name mentioned; and still, *S. splendens* Baumann was amply published.

To *S. Hellcri*, I refer, besides the type, the following specimens:

California: Summit, Central Pacific Railroad, July, 1877, *H. Edwards*.

S. japonica is occasionally found escaped from cultivation. I have seen the following specimens:

Pennsylvania: Point Pleasant, July 11, 1898, *C. D. Fretz*; Liberty, September 1, 1906, *J. K. Small*.

S. salicifolia is not found native on this continent. What has gone under that name, is partly *S. latifolia*, and partly *S. alba*. The former is distinguished by its broad, obovate or oblanceolate leaves and almost glabrous inflorescence. When the flowers first open, they are usually more or less pinkish; but in age they become white. Even in "Gray's New Manual," *S. alba* is described as *S. salicifolia*. The two resemble each other in the narrower leaves and the pubescent inflorescence, but differ in the flowers, which in *S. alba* are white instead of deep pink, and in the leaves, which are broader above instead of below or at the middle.

In Canada and northern New England and New York there

is a form of *S. latifolia*, growing in rocky places, especially along streams, with short broad leaves, rounded at the apex and coarsely toothed. It is also much lower than the ordinary *S. latifolia*, and the stems usually die back each year to near the base. This was described as *S. obovata* by Rafinesque. Usually it is very unlike the ordinary *S. latifolia*, but intermediate forms are not infrequent. This form needs more field study.

In the North America Flora, there are five new species proposed. These, together with *S. pyramidata*, the author is inclined to regard as hybrids, except *S. Helleri*. Hybrids are not uncommon in the genus *Spiraea*. *S. Nobleana* was described by J. D. Hooker from a plant raised in a California nursery. It is supposed to be a hybrid between *S. Douglasii* and *S. salicifolia*. As one of the supposed parents is a native of North America and the other is occasionally found spontaneously, and as the plant originated in America apparently without the help of man, it might have been included in the North American Flora, but it was excluded therefrom, like all other garden plants. The native species of probable hybrid origin and their probable parents are as follows:

S. roseata = *S. Menziesii* × *densiflora*.
S. subvillosa = *S. Douglasii* × *densiflora*.
S. tomentulosa = *S. Douglasii* × *lucida*.
S. pyramidata = *S. Menziesii* × *lucida*.
S. subcanescens = *S. tomentosa* × *alba*.

Spiraea tomentulosa, and *S. subcanescens* are known only from the type locality. *S. subvillosa* has been collected also at the following station:

Oregon: Hood River, Cascade Mountains, Aug. 1, 1894, *F. E. Lloyd*.

S. roseata has been collected at the following locality:

Idaho: Near Cooper's, July 20, 1892, *Isabel Mulford*.

PETROPHYTUM AND KELSEYA

It is gratifying to the author, that C. K. Schneider,* a rather conservative dendrologist, has independently raised these to generic rank. The genera are related to *Spiraea*, but are distinguished by the peculiar habit and by the structure of their fruits. To

* Handb. Laubh. 1: 484, 485. 1905.

merge them into *Eriogynia*, or *Luetkea*, as was done by S. Watson, O. Kuntze, and E. L. Greene, is rather indefensible; and it is strange that A. A. Heller, who recognized *Petrophytum caespitosum* and *P. elatior* as representing a distinct genus, should transfer the closely related *Spiraea cinerascens* to *Luetkea*. In the Flora are recognized five species of *Petrophytum*. Of these one, viz., *P. acuminatum*, is proposed as new. It is known only from the type locality. *Kelseya* is monotypic.

LUETKEA

It is doubtful which of the two names, *Luetka* or *Eriogynia*, is the older. Otto Kuntze, when adopting *Luetkea* instead of *Eriogynia*, claimed that the former was published in 1831 and the latter in 1833. It is most probable that they were both published in 1832. The part of the Memoirs of the Academy of St. Petersburg in which Bongard's paper on the vegetation of Sitka was published, appeared in August, 1832. Whether any separates were distributed before that time we can not ascertain. *Eriogynia* was published in 1832, apparently in the later part of the year, but the exact date is unknown. For that reason I did not change the now accepted name of the genus.

The generic name was originally spelled *Lütkea*. As the German *ü* is not found in Latin, it is usually replaced by *ue*. *Luetkea* is therefore preferable to *Lutkea*.

ARUNCUS

The plants of this genus native to the eastern United States have invariably much smaller fruit than the European plants. The plant common in the Alleghanies has thinner, more glossy leaves and rather thick fruit. It is *Aruncus sylvestris americanus* of Maximovicz, but unfortunately the synonym, *Spiraea Aruncus americana* Pers., from which Maximovicz adopted the name, is very doubtful. It may belong, as well as all the synonyms under *A. alleghanensis*, except the last, to *Astilbe* instead of *Aruncus*. Hence a new name was proposed.

The *Aruncus* of the Mississippi valley has rather thick, densely pubescent leaves and more slender fruit. It was described under the name of *A. pubescens*.

The plant of northwestern North America is much closer to the European *Aruncus Aruncus*, and differs practically only in the long-acuminate leaflets. If any of the American species of *Aruncus* should be reduced to the Old World species, it should be *A. acuminatus*. *A. Aruncus* is common in cultivation and rarely escaped.

To these four species is to be added an East Siberian species *A. kamchaticus*, which has been collected on *Attu*, the most westerly of the Aleutian Islands.

NEW YORK BOTANICAL GARDEN.

Studies in North American Peronosporales—IV. Host index

GUY WEST WILSON

The present host index of the North American species of the order Peronosporales has been prepared with a view of bringing together in a convenient form for reference all the published hosts of these fungi. The list has been made as complete as possible and such cross-references as will facilitate its use are given, while care has been taken not to overburden the index with useless synonyms. No new hosts are recorded in this index and no attempt is made to unravel tangles of synonymy or specific limitations, but the index represents as completely as possible our present knowledge of the host distribution of the commonly recognized American species of the order.

AIZOACEAE

TRIANTHEMA PORTULACASTRUM L.
Albugo Trianthemae G. W. Wilson.

ALLIACEAE

ALLIUM CEPA L.
Peronospora Schleideni Unger.

ALSINACEAE

CERASTIUM CERASTIOIDES (L.) Britton.
Peronospora Alsinearum Caspary.
CERASTIUM LONGIPEDUNCULATUM Muhl.
Peronospora Alsinearum Caspary.
CERASTIUM NUTANS Raf.; see *C. longipedunculatum* Muhl.
CERASTIUM TRIGYNUM Vill.; see *C. cerastioides* (L.) Britton.
CERASTIUM VISCOSUM L.
Peronospora Alsinearum Caspary.
CERASTIUM VULGATUM L.
Peronospora Alsinearum Caspary.
CERASTIUM sp.
Peronospora Alsinearum Caspary.
SILENE ANTIRRHINA L.
Peronospora Arenariae macrospora Farl.
SILENE sp.
Peronospora Arenariae macrospora Farl.
SPERGULA ARVENSIS L.
Peronospora Alsinearum Caspary.
TISSA LEUCANTHA (Robins.) Greene.
Albugo Lepigoni (de Bary) Kuntze.
TISSA MARINA (L.) Britton.
Albugo Lepigoni (de Bary) Kuntze.

ALLIONIACEAE

ALLIONIA INCARNATA L.; see *Wedelia incarnata* (L.)Kuntze.
ALLIONIA NYCTAGINEA Michx.
Peronospora Oxybaphi E. & E.
BOERHAAVIA ANISOPHYLLA A. Gray.
Albugo platensis (Speg.) Swingle.
BOERHAAVIA DIFFUSA L.
Albugo platensis (Speg.) Swingle.
BOERHAAVIA ERECTA L.
Albugo platensis (Speg.) Swingle.
BOERHAAVIA HIRSUTA Willd.
Albugo platensis (Speg.) Swingle.
BOERHAAVIA PANICULATA Rich.
Albugo platensis (Speg.) Swingle.
BOERHAAVIA SONORAE Rose.
Albugo platensis (Speg.) Swingle.
BOERHAAVIA SPICATA Choisy.
Albugo platensis (Speg.) Swingle.
BOERHAAVIA VISCOSA Lag. & Rodr.
Albugo platensis (Speg.) Swingle.
BOERHAAVIA XANTI S. Wats.
Albugo platensis (Speg.) Swingle.
OXYBAPHUS NYCTAGINEUS Sweet; see *Allionia nyctaginea* Michx.
WEDELIA INCARNATA (L.) Kuntze.
Albugo platensis (Speg.) Swingle.

AMARANTHACEAE

ACNIDA CANNABINA L.
Albugo Bliti (Biv.) Kuntze.

ACNIDA TAMARISCINA (Nutt.) Willd.
Albugo Bliti (Biv.) Kuntze.

ACNIDA TAMARISCINA TUBERCULATA (Moq.) Uline & Bray.
Albugo Bliti (Biv.) Kuntze.

ACNIDA TUBERCULATA Moq.; see *A. tamariscina tuberculata* (Moq.) Uline & Bray.

AMARANTHUS ALBUS L.; see *A. graecizans* L.

AMARANTHUS BIGELOVII Uline & Bray.
Albugo Bliti (Biv.) Kuntze.

AMARANTHUS BLITOIDES S. Wats.
Albugo Bliti (Biv.) Kuntze.

AMARANTHUS CHLOROSTACHYS L.; see *A. hybridus* L.

AMARANTHUS CRISPUS (Lesp. & Thev.) Braun.
Albugo Bliti (Biv.) Kuntze.

AMARANTHUS EMARGINATUS Salzm.
Albugo Bliti (Biv.) Kuntze.

AMARANTHUS GRAECIZANS L.
Albugo Bliti (Biv.) Kuntze.

AMARANTHUS HYBRIDUS L.
Albugo Bliti (Biv.) Kuntze.

AMARANTHUS HYBRIDUS PANICULATUS (L.) Uline & Bray.
Albugo Bliti (Biv.) Kuntze.

AMARANTHUS PALMERI S. Wats.
Albugo Bliti (Biv.) Kuntze.

AMARANTHUS PANICULATUS L.; see A. *hybridus paniculatus* (L.) Uline & Bray.

AMARANTHUS RETROFLEXUS L.
Albugo Bliti (Biv.) Kuntze.

AMARANTHUS SPINOSUS L.
Albugo Bliti (Biv.) Kuntze.

AMARANTHUS TRISTIS L.
Albugo Bliti (Biv.) Kuntze.

AMARANTHUS VIRIDIS L.
Albugo Bliti (Biv.) Kuntze.

AMARANTHUS sp.
Albugo Bliti (Biv.) Kuntze.

CLADOTHRIX LANUGINOSA (Moq.) Nuttall.
Albugo Froelichiae G. W. Wilson.

"CYATHULA LAPPULACEA."
Albugo Bliti (Biv.) Kuntze.

FROELICHIA CAMPESTRIS Small.
Albugo Froelichiae G. W. Wilson.

FROELICHIA FLORIDANA (Nutt.) Moq.; see *F. campestris* Small.

FROELICHIA GRACILIS Moq.
Albugo Froelichiae G. W. Wilson.

AMBROSIACEAE

AMBROSIA ARTEMISIAEFOLIA L.
Albugo Tragopogonis (DC.) S. F. Gray.
Rhysotheca Halstedii (Farl.) G. W. Wilson.

AMBROSIA PSILOSTACHYA DC.
Albugo Tragopogonis (DC.) S. F. Gray.
Rhysotheca Halstedii (Farl.) G. W. Wilson.

AMBROSIA TRIFIDA L.
Albugo Tragopogonis (DC.) S. F. Gray.
Rhysotheca Halstedii (Farl.) G. W. Wilson.

AMBROSIA sp.
Albugo Tragopogonis (DC.) S. F. Gray.

FRANSERIA DISCOLOR Nutt.; see *Gaertneria discolor* (Nutt.) Kuntze.

FRANSERIA TENUIFOLIA A. Gray; see *Iva ambrosiaefolia* A. Gray.

GAERTNERIA ACANTHOCARPA (Hook.) Britton.
Albugo Tragopogonis (DC.) S. F. Gray.

GAERTNERIA DISCOLOR (Nutt.) Kuntze.
Albugo Tragopogonis (DC.) S. F. Gray.

IVA AMBROSIAEFOLIA A. Gray.
Albugo Tragopogonis (DC.) S. F. Gray.

IVA CILIATA Willd.
Albugo Tragopogonis (DC.) S. F. Gray.

IVA XANTHIIFOLIA Nutt.
Basidiophora Kellermanii (E. & H.) G. W. Wilson.
Rhysotheca Halstedii (Farl.) G. W. Wilson.

XANTHIUM CANADENSE Mill.
Rhysotheca Halstedii (Farl.) G. W. Wilson.

APIACEAE

"UMBELLIFERAE" gen. et sp. ignot.
Rhysotheca Umbelliferarum (Caspary) G. W. Wilson.

ARACEAE

CALADIUM COLOCASIA (L.) W. F. Wight.
Peronospora trichomata Massee.

COLOCASIA ANTIQUORUM Schott; see *Caladium Colocasia* (L.) W. F. Wight.

ASCLEPIADACEAE

GONOLOBUS MACROPHYLLUS Michx.; see *Vincetoxicum gonocarpos* Walt.

GONOLOBUS SUBEROSUS (L.) R. Br.; see *Vincetoxicum suberosum* (L.) Britton.

GONOLOBUS sp.; see *Vincetoxicum hirsutum* (Michx.) Britton.

VINCETOXICUM GONOCARPOS Walt.
Rhysotheca Gonolobi (Lagerh.) G. W. Wilson.

VINCETOXICUM HIRSUTUM (Michx.) Britton.
Rhysotheca Gonolobi (Lagerh.) G. W. Wilson.

VINCETOXICUM SUBEROSUM (L.) Britton.
Rhysotheca Gonolobi (Lagerh.) G. W. Wilson.

VINCETOXICUM sp.; see *V. hirsutum* (Michx.) Britton.

BALSAMINACEAE

IMPATIENS AUREA Muhl.
Rhysotheca obducens (Schröt.) G. W. Wilson.
IMPATIENS BIFLORA Walt.
Rhysotheca obducens (Schröt.) G. W. Wilson.
IMPATIENS FULVA Nutt.; see *I. biflora* Walt.
IMPATIENS PALLIDA Nutt.; see *I. aurea* Muhl.
IMPATIENS sp.
Rhysotheca obducens (Schröt.) G. W. Wilson.

BORAGINACEAE

CYNOGLOSSUM OFFICINALE L.
Peronospora Cynoglossi Burrill.
ECHINOSPERMUM REDOWSKII CUPULATUM A. Gray; see *Lappula cupulata* (A. Gray) Rydb.
ECHINOSPERMUM REDOWSKII OCCIDENTALE S. Wats.; see *Lappula occidentalis* (S. Wats.) Greene.
LAPPULA CUPULATA (A. Gray) Rydb.
Peronospora Echinospermi Swingle.
LAPPULA FLORIBUNDA (Lehm.) Greene.
Peronospora Echinospermi Swingle.
LAPPULA OCCIDENTALIS (S. Wats.) Greene.
Peronospora Echinospermi Swingle.
LAPPULA TEXANA (Scheele) Britton.
Peronospora Echinospermi Swingle.
MYOSOTIS VERNA Nutt.
Peronospora Myosotidis de Bary.

BRASSICACEAE

ARABIS FURCATA S. Wats.
Albugo candida (Pers.) Rouss.
ARABIS GLABRA (L.) Bernh.
Albugo candida (Pers.) Rouss.
ARABIS HIRSUTA Scop.
Peronospora parasitica (Pers.) de Bary.
ARABIS HOLBOELLII Hornem.
Peronospora parasitica (Pers.) de Bary.
ARABIS LYRATA L.
Albugo candida (Pers.) Rouss.
ARABIS VIRGINICA (L.) Trel.
Albugo candida (Pers.) Rouss.
ARABIS sp.
Peronospora parasitica (Pers.) de Bary.
BARBAREA BARBAREA (L.) McM.
Albugo candida (Pers.) Rouss.
BARBAREA VULGARIS R. Br.; see *B. Barbarea* (L.) McM.
BRASSICA ALBA (L.) Boiss.; see *Sinapis alba* L.
BRASSICA ARVENSIS (L.) B.S.P.
Albugo candida (Pers.) Rouss.
Peronospora parasitica (Pers.) de Bary.
BRASSICA CAMPESTRIS L.
Albugo candida (Pers.) Rouss.
Peronospora parasitica (Pers.) de Bary.
BRASSICA INTEGRIFOLIA (West) O. E. Schultz.
Albugo candida (Pers.) Rouss.
BRASSICA NIGRA (L.) Koch.
Albugo candida (Pers.) Rouss.
Peronospora parasitica (Pers.) de Bary.
BRASSICA OLERACEA L.
Albugo candida (Pers.) Rouss.
Peronospora parasitica (Pers.) de Bary.
BRASSICA SATIVA; see *B. oleracea* L.
BRASSICA SINAPISTRUM Boiss.; see *B. arvensis* (L.) B.S.P.
BRASSICA sp.
Albugo candida (Pers.) Rouss.
Peronospora parasitica (Pers.) de Bary.
BURSA BURSA-PASTORIS (L.) Britton.
Albugo candida (Pers.) Rouss.
Peronospora parasitica (Pers.) de Bary.
CAKILE AMERICANA Nutt.; see *C. edentula* (Bigel.) Hook.
CAKILE EDENTULA (Bigel.) Hook.
Albugo candida (Pers.) Rouss.
CAMELINA MICROCARPA Andrz.
Albugo candida (Pers.) Rouss.
CAMELINA SATIVA (L.) Crantz; see *C. microcarpa* Andrz.
CAPSELLA BURSA-PASTORIS (L.) Moench.; see *Bursa Bursa-pastoris* (L.) Britton.
CARDAMINE BULBOSA (Schreb.) B.S.P.
Albugo candida (Pers.) Rouss.
Peronospora parasitica (Pers.) de Bary.
CARDAMINE HIRSUTA (L.).
Peronospora parasitica (Pers.) de Bary.
CARDAMINE LACINIATA Wood; see *Dentaria laciniata* Muhl.
CARDAMINE LUDOVICIANA Hook.; see *Arabis virginica* (L.) Trel.
CARDAMINE RHOMBOIDEA DC.; see *C. bulbosa* (Schreb.) B.S.P.
CHEIRANTHUS ASPER Nutt.
Albugo candida (Pers.) Rouss.
CHEIRANTHUS CHEIRI L.
Albugo candida (Pers.) Rouss.
CHEIRANTHUS PACIFICUM Sheldon.
Albugo candida (Pers.) Rouss.
COCHLEARIA ARMORACIA L.; see *Roripa Armoracia* (L.) A. S. Hitchcock.
COCHLEARIA OLERACEA; see *Roripa Armoracia* (L.) A. S. Hitchcock.
CORONOPUS sp.
Albugo candida (Pers.) Rouss.
DENTARIA DIPHYLLA Michx.
Albugo candida (Pers.) Rouss.
DENTARIA HETEROPHYLLA Nutt.
Peronospora parasitica (Pers.) de Bary.
DENTARIA LACINIATA Muhl.
Albugo candida (Pers.) Rouss.
Peronospora parasitica (Pers.) de Bary.
DENTARIA MAXIMA Nutt.
Peronospora parasitica (Pers.) de Bary.

DENTARIA sp.
Peronospora parasitica (Pers.) de Bary.
DRABA CAROLINIANA Walt.
Albugo candida (Pers.) Rouss.
Peronospora parasitica (Pers.) de Bary.
HESPERIS MATRONALIS L.
Albugo candida (Pers.) Rouss.
Peronospora parasitica (Pers.) de Bary.
IODANTHUS PINNATIFIDUS (Michx.) Steud.
Albugo candida (Pers.) Rouss.
Peronospora parasitica (Pers.) de Bary.
KONIGA MARITIMA (L.) R. Br.
Peronospora parasitica (Pers.) de Bary.
LEPIDIUM CAMPESTRE (L.) R. Br.
Albugo candida (Pers.) Rouss.
LEPIDIUM DENSIFLORUM Schrad.
Albugo candida (Pers.) Rouss.
Peronospora parasitica (Pers.) de Bary.
LEPIDIUM INCISUM; error for *Sisymbrium incisum* Engelm.
LEPIDIUM INTERMEDIUM A. Gray; see *L. densiflorum* Schrad.
LEPIDIUM SATIVUM L.
Albugo candida (Pers.) Rouss.
Peronospora parasitica (Pers.) de Bary.
LEPIDIUM VIRGINICUM L.
Albugo candida (Pers.) Rouss.
Peronospora parasitica (Pers.) de Bary.
LEPIDIUM sp.
Peronospora parasitica (Pers.) de Bary.
(See also *L. virginicum* L.)
NASTURTIUM; see *Roripa.*
NESLIA PANICULATA Desv.
Albugo candida (Pers.) Rouss.
RAPHANUS SATIVUS L.
Albugo candida (Pers.) Rouss.
Peronospora parasitica (Pers.) de Bary.
RORIPA ARMORACIA (L.) A. S. Hitchcock.
Albugo candida (Pers.) Rouss.
Peronospora parasitica (Pers.) de Bary.
RORIPA HISPIDA (Desv.) Britton.
Albugo candida (Pers.) Rouss.
Peronospora parasitica (Pers.) de Bary.
RORIPA OBTUSA (Nutt.) Britton.
Albugo candida (Pers.) Rouss.
Peronospora parasitica (Pers.) de Bary.
RORIPA PALUSTRIS (DC.) Bessey.
Albugo candida (Pers.) Rouss.
Peronospora parasitica (Pers.) de Bary.
RORIPA SESSILIFLORA (Nutt.) A. S. Hitchcock.
Albugo candida (Pers.) Rouss.
RORIPA SINUATA (Nutt.) A. S. Hitchcock.
Albugo candida (Pers.) Rouss.
RORIPA WALTERI (Ell.) Mohr.
Albugo candida (Pers.) Rouss.
SCHOENOCRAMBE LINIFOLIUM (Nutt.) Greene.
Albugo candida (Pers.) Rouss.
SINAPIS ALBA L.
Albugo candida (Pers.) Rouss.
Peronospora parasitica (Pers.) de Bary.
SINAPIS ARVENSIS L.; see *Brassica arvensis* (L.) B.S.P.
SISYMBRIUM CANESCENS Nutt.; see *Sophia pinnata* (Walt.) Britton.
SISYMBRIUM INCISUM Engelm.; see *Sophia incisa* (Engelm.) Greene.
SISYMBRIUM OFFICINALE (L.) Scop.
Albugo candida (Pers.) Rouss.
SISYMBRIUM sp.
Peronospora parasitica (Pers.) de Bary.
SOPHIA HARTWEGIANA (Tourn.) Greene.
Albugo candida (Pers.) Rouss.
SOPHIA INCISA (Engelm.) Greene.
Peronospora parasitica (Pers.) de Bary.
SOPHIA PINNATA (Walt.) Britton.
Albugo candida (Pers.) Rouss.
Peronospora parasitica (Pers.) de Bary.
SOPHIA sp.
Peronospora parasitica (Pers.) de Bary.
THELYPODIUM PINNATIFIDUM S. Wats.; see *Iodanthus pinnatifidus* Steud.
THLASPI GLAUCUM A. Nelson.
Albugo candida (Pers.) Rouss.
THLASPI NUTTALLII Rydb.
Albugo candida (Pers.) Rouss.

CAPRIFOLIACEAE

VIBURNUM ACERIFOLIUM L.
Rhysotheca Viburni (Peck) G. W. Wilson.
VIBURNUM DENTATUM L.
Rhysotheca Viburni (Peck) G. W. Wilson.
VIBURNUM NUDUM L.
Rhysotheca Viburni (Peck) G. W. Wilson.
VIBURNUM OPULUS L.
Rhysotheca Viburni (Peck) G. W. Wilson.
VIBURNUM PUBESCENS (Ait.) Pursh.
Rhysotheca Viburni (Peck) G. W. Wilson.

CARDUACEAE

ANTENNARIA PLANTAGINIFOLIA (L.) Rich.
Albugo Tragopogonis (DC.) S. F. Gray.
ARTEMISIA BIENNIS Willd.
Albugo Tragopogonis (DC.) S. F. Gray.
Peronospora leptosperma de Bary.
ARTEMISIA CANADENSIS Michx.
Albugo Tragopogonis (DC.) S. F. Gray.
ARTEMISIA LUDOVICIANA Nutt.
Peronospora leptosperma de Bary.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
ARTEMISIA sp.
Peronospora leptosperma de Bary.
ASTER NOVAE-ANGLIAE L.
Basidiophora entospora Roze & Cornu.
ASTER OBLONGIFOLIUS Nutt.
Basidiophora entospora Roze & Cornu.

ASTER SAGITTIFOLIUS Willd.
Basidiophora entospora Roze & Cornu.
ASTER sp.
Basidiophora entospora Roze & Cornu.
BIDENS CERNUA L.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
BIDENS CHRYSANTHEMOIDES Michx.; see *B. laevis* (L.) B.S.P.
BIDENS COMOSA (A. Gray) Wiegand.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
BIDENS CONNATA Muhl.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
BIDENS CONNATA COMOSA A. Gray; see *B. comosa* (A. Gray) Wiegand.
BIDENS FRONDOSA L.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
BIDENS LAEVIS (L.) B.S.P.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
CARDUUS ARVENSIS (L.) Robs.
Albugo Tragopogonis (DC.) S. F. Gray.
CARDUUS LANCEOLATUS L.
Albugo Tragopogonis (DC.) S. F. Gray.
CARDUUS MUTICUS (Michx.) Pers.
Albugo Tragopogonis (DC.) S. F. Gray.
CARDUUS SPINOSISSIMUS Walt.
Albugo Tragopogonis (DC.) S. F. Gray.
CARDUUS UNDULATUS Nutt.
Albugo Tragopogonis (DC.) S. F. Gray.
CENTAUREA sp.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
CIRSIUM ARVENSE (L.) Scop.; see *Carduus arvensis* (L.) Robs.
CNICUS ARVENSIS (L.) Hook.; see *Carduus arvensis* (L.) Robs.
CNICUS HORRIDULUS Pursh; see *Carduus spinosissimus* Walt.
CNICUS LANCEOLATUS Hoffm.; see *Carduus lanceolatus* L.
CNICUS MUTICUS (Michx.) Ell.; see *Carduus muticus* (Michx.) Pers.
CNICUS sp.; see *Carduus muticus* (Michx.) Pers.
ERECHTITES HIERACIFOLIA (L.) Raf.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
ERIGERON ANNUUS (L.) Pers.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
ERIGERON CANADENSIS L.; see *Leptilon canadense* (L.) Britton.
ERIGERON PHILADELPHICUS L.
Basidiophora entospora Roze & Cornu.
ERIGERON RAMOSUS Willd.
Basidiophora entospora Roze & Cornu.
ERIGERON sp.
Basidiophora entospora Roze & Cornu.
EUPATORIUM AGERATOIDES L.f.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
EUPATORIUM PURPUREUM L.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
GNAPHALIUM PURPUREUM L.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
GNAPHALIUM SPATHULATUM L.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
HELIANTHUS ANNUUS L.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
HELIANTHUS DIVARICATUS L.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
HELIANTHUS DORONICOIDES Lam.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
HELIANTHUS GROSSESERRATUS Martens.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
HELIANTHUS HIRSUTUS Raf.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
HELIANTHUS MAXIMILIANI Schrad.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
HELIANTHUS OCCIDENTALIS Riddell.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
HELIANTHUS SCABERRIMUS Ell.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
HELIANTHUS STRUMOSUS L.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
HELIANTHUS TRACHELIIFOLIUS Mill.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
HELIANTHUS TUBEROSUS L.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
HELIANTHUS sp.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
(See also *Iva ciliata* Willd.)
LEPTILON CANADENSE (L.) Britton.
Basidiophora entospora Roze & Cornu.
MADIA SATIVA Molina.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
MATRICARIA MATRICARIOIDES (Less.) Porter.
Albugo Tragopogonis (DC.) S. F. Gray.
PARTHENIUM INTEGRIFOLIUM L.
Albugo Tragopogonis (DC.) S. F. Gray.

PARTHENIUM REPENS Eggert.
Albugo Tragopogonis (DC.) S. F. Gray.
RUDBECKIA FULGIDA Ait.
Basidiophora entospora Roze & Cornu.
RUDBECKIA LACINIATA L.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
RUDBECKIA TRILOBA L.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
SENECIO AUREUS L.
Albugo Tragopogonis (DC.) S. F. Gray.
(See also *Senecio oblanceolatus* Rydb.)
SENECIO AUREUS CROCEUS A. Gray; see *S. cymbalarioides* Nutt.
SENECIO CYMBALARIOIDES Nutt.
Albugo Tragopogonis (DC.) S. F. Gray.
SENECIO HARTIANUS Heller.
Albugo Tragopogonis (DC.) S. F. Gray.
SENECIO LUGENS Rich.
Albugo Tragopogonis (DC.) S. F. Gray.
SENECIO MACDOUGALII Heller.
Albugo Tragopogonis (DC.) S. F. Gray.
SENECIO OBLANCEOLATUS Rydb.
Albugo Tragopogonis (DC.) S. F. Gray.
SENECIO PENINSULARIS Vasey & Rose.
Albugo Tragopogonis (DC.) S. F. Gray.
SENECIO SERRA Hooker.
Albugo Tragopogonis (DC.) S. F. Gray.
SENECIO SERRA INTEGRIFOLIA A. Gray.
Albugo Tragopogonis (DC.) S. F. Gray.
SENECIO VULGARIS L.
Bremia Lactucae Regel.
SENECIO sp.
Albugo Tragopogonis (DC.) S. F. Gray.
SILPHIUM INTEGRIFOLIUM Michx.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
SILPHIUM LACINIATUM L.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
SILPHIUM PERFOLIATUM L.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
SILPHIUM TEREBINTHINACEUM Jacq.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
SILPHIUM TRIFOLIATUM L.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
SOLIDAGO CANADENSIS L.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
SOLIDAGO RIDDELLII Frank.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
SOLIDAGO RIGIDA L.
Basidiophora entospora Roze & Cornu.
SOLIDAGO sp.
Basidiophora entospora Roze & Cornu.
VERNONIA BALDWINII Torr.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
VERNONIA NOVEBORACENSIS (L.) Michx.
Rhysotheca Halstedii (Farl.) G. W. Wilson.
VERBESINA ENCELIOIDES (Cav.) A. Gray.
Rhysotheca Halstedii (Farl.) G. W. Wilson.

CHENOPODIACEAE

ATRIPLEX HASTATA L.
Peronospora effusa Rabenh.
BETA VULGARIS L.
Albugo? occidentalis G. W. Wilson.
BLITUM CAPITATUM L.
Albugo occidentalis G. W. Wilson.
CHENOPODIUM ALBUM L.
Peronospora effusa Rabenh.
CHENOPODIUM ALBUM VIRIDE (L.) Moq.
Peronospora effusa Rabenh.
CHENOPODIUM HYBRIDUM L.
Peronospora effusa Rabenh.
CHENOPODIUM LEPTOPHYLLUM (Moq.) Nutt.
Peronospora effusa Rabenh.
CHENOPODIUM RUBRUM L.
Albugo occidentalis G. W. Wilson.
CHENOPODIUM sp.
Peronospora effusa Rabenh.
SPINACIA OLERACEA L.
Peronospora effusa Rabenh.

CICHORIACEAE

ADOPOGON DANDELION (L.) Kuntze.
Bremia Lactucae Regel.
AGOSERIS sp.
Bremia Lactucae Regel.
CICHORIUM INTYBUS L.
Bremia Lactucae Regel.
KRIGIA DANDELION (L.) Nutt.; see *Adopogon Dandelion* (L.) Kuntze.
LACTUCA ALTISSIMA; error for *Nabalus altissimus*.
LACTUCA CANADENSIS L.
Bremia Lactucae Regel.
LACTUCA HIRSUTA Muhl.
Bremia Lactucae Regel.
LACTUCA INTEGRIFOLIA Bigel.; see *L. sagittifolia* Ell.
LACTUCA LEUCOPHAEA A. Gray; see *L. sativa* (Lam.) A. S. Hitchcock.
LACTUCA LUDOVICIANA (Nutt.) DC.
Bremia Lactucae Regel.
LACTUCA PULCHELLA (Pursh) DC.
Bremia Lactucae Regel.
LACTUCA SAGITTIFOLIA Ell.
Bremia Lactucae Regel.
LACTUCA SATIVA L.
Bremia Lactucae Regel.

LACTUCA SPICATA (Lam.) A. S. Hitchcock.
Bremia Lactucae Regel.
LACTUCA sp.
Bremia Lactucae Regel.
MULGEDIUM LEUCOPHAEUM DC.; see *Lactuca spicata* (Lam.) A. S. Hitchcock.
NABALUS ALBUS (L.) Hook.
Bremia Lactucae Regel.
NABALUS ALTISSIMUS (L.) Hook.
Bremia Lactucae Regel.
PRENANTHES ALTISSIMA L.; see *Nabalus altissimus* (L.) Hook.
SONCHUS ASPER (L.) All.
Bremia Lactucae Regel.
SONCHUS sp.
Bremia Lactucae Regel.
TRAGOPOGON PORRIFOLIUS L.
Albugo Tragopogonis (DC.) S. F. Gray.

CONVOLVULACEAE

BATATAS EDULIS (L.) Choisy; see *Ipomoea Batatas* (L.) Lam.
CALONYCTION ACULEATUM (L.) House.
Albugo Ipomoeae-panduranae (Schwein.) Swingle.
CALYSTEGIA SEPIUM (L.) R. Br.; see *Convolvulus Sepium* L.
CONVOLVULUS BATATAS L.; see *Ipomoea Batatas* (L.) Lam.
CONVOLVULUS INCANUS Vahl.
Albugo Ipomoeae-panduranae (Schwein.) Swingle.
CONVOLVULUS MACRORRHIZA; see *Ipomoea pandurata* (L.) Meyer.
CONVOLVULUS SEPIUM L.
Albugo Ipomoeae-panduranae (Schwein.) Swingle.
CONVOLVULUS sp.; see *Ipomoea hederacea* L.
CONVOLVULACEAE, gen. et sp. ignot.
Albugo Ipomoeae-panduranae (Schwein.) Swingle.
IPOMOEA BATATAS (L.) Lam.
Albugo Ipomoeae-panduranae (Schwein.) Swingle.
IPOMOEA CAROLINA (L.) Pursh.
Albugo Ipomoeae-panduranae (Schwein.) Swingle.
IPOMOEA COMMUTATA R. & S.; see *I. Carolina* Pursh.
IPOMOEA HEDERACEA (L.) Jacq.
Albugo Ipomoeae-panduranae (Schwein.) Swingle.
IPOMOEA INCARNATA Vahl.
Albugo Ipomoeae-panduranae (Schwein.) Swingle.
IPOMOEA LACUNOSA L.
Albugo Ipomoeae-panduranae (Schwein.) Swingle.
IPOMOEA LEPTOPHYLLA Torr.
Albugo Ipomoeae-panduranae (Schwein.) Swingle.
IPOMOEA MEXICANA A. Gray.
Albugo Ipomoeae-panduranae (Schwein.) Swingle.
IPOMOEA PANDURATA (L.) Meyer.
Albugo Ipomoeae-panduranae (Schwein.) Swingle.
IPOMOEA PES-CAPRAE (L.) Roth.
Albugo Ipomoeae-panduranae (Schwein.) Swingle.
IPOMOEA PURPUREA (L.) Lam.
Albugo Ipomoeae-panduranae (Schwein.) Swingle.
IPOMOEA TAMNIFOLIA L.; see *Jacquemontia tamnifolia* (L.) Griseb.
IPOMOEA TRICHOCARPA Ell.
Albugo Ipomoeae-panduranae (Schwein.) Swingle.
IPOMOEA TRILOBA L.
Albugo Ipomoeae-panduranae (Schwein.) Swingle.
JACQUEMONTIA TAMNIFOLIA (L.) Griseb.
Albugo Ipomoeae-panduranae (Schwein.) Swingle.
QUAMOCLIT QUAMOCLIT (L.) Britton.
Albugo Ipomoeae-panduranae (Schwein.) Swingle.
QUAMOCLIT VULGARIS L.; see *Q. Quamoclit* (L.) Britton.

CUCURBITACEAE

BRYONOPSIS LACINIOSA ERYTHROCARPA Naud.
Pseudoperonospora cubensis (B. & C.) Rostow.
CITRULLUS VULGARIS Schrad.
Pseudoperonospora cubensis (B. & C.) Rostow.
COCCINIA INDICA Wight & Arn.
Pseudoperonospora cubensis (B. & C.) Rostow.
CUCUMIS ANGURIA L.
Pseudoperonospora cubensis (B. & C.) Rostow.
CUCUMIS ANGULATUS Forsk.
Pseudoperonospora cubensis (B. & C.) Rostow.
CUCUMIS DIPSACEUS Ehrenb.
Pseudoperonospora cubensis (B. & C.) Rostow.
CUCUMIS ERINACEUS; horticultural name for *C. dipsaceus* Ehrenb.
CUCUMIS MELO L.
Pseudoperonospora cubensis (B. & C.) Rostow.
CUCUMIS ODORATISSIMUS Moench.
Pseudoperonospora cubensis (B. & C.) Rostow.
CUCUMIS SATIVUS L.
Pseudoperonospora cubensis (B. & C.) Rostow.

CUCURBITA MAXIMA Duch.
Pseudoperonospora cubensis (B. & C.) Rostow.
CUCURBITA ESCULENTA S. F. Gray; see *Cucurbita Pepo* L.
CUCURBITA OVIFERA L.
Pseudoperonospora cubensis (B. & C.) Rostow.
CUCURBITA PEPO L.
Pseudoperonospora cubensis (B. & C.) Rostow.
CUCURBITA VERRUCOSA L.; see *C. Pepo* L.
CUCURBITACEAE, gen. et sp. ignot.
Pseudoperonospora cubensis (B. & C.) Rostow.
ECHINOCYSTIS LOBATA (Michx.) T. & G.; see *Micrampelis lobata* (Michx.) A. Gray.
LAGENARIA VULGARIS Ser.
Pseudoperonospora cubensis (B. & C.) Rostow.
MELOTHRIA SCABRA Naud.
Pseudoperonospora cubensis (B. & C.) Rostow.
MICRAMPELIS ECHINATA (Muhl.) B.S.P.; see *M. lobata* (Michx.) A. Gray.
MICRAMPELIS LOBATA (Michx.) A. Gray.
Pseudoperonospora cubensis (B. & C.) Rostow.
Rhysotheca australis (Speg.) G. W. Wilson.
MOMORDICA BALSAMINA L.
Pseudoperonospora cubensis (B. & C.) Rostow.
MOMORDICA CHARANTIA L.
Pseudoperonospora cubensis (B. & C.) Rostow.
MUKIA SCABRELLA Arn.
Pseudoperonospora cubensis (B. & C.) Rostow.
SICYOS ANGULATUS L.
Rhysotheca australis (Speg.) G. W. Wilson.
TRICHOSANTHES ANGUINA L.
Pseudoperonospora cubensis (B. & C.) Rostow.
TRICHOSANTHES COLUMBRINA Jacq.; see *T. Anguina* L.

DIPSACEAE

DIPSACUS SYLVESTRIS Huds.
Peronospora Dipsaci Tul.

EUPHORBIACEAE

CHAMAESYCE CORDIFOLIA (Ell.) Small.
Peronospora Euphorbiae Fuckel.
CHAMAESYCE GLYPTOSPERMA (Engelm.) Small.
Peronospora Euphorbiae Fuckel.
CHAMAESYCE HIRTULA (Engelm.) Small.
Peronospora Euphorbiae Fuckel.
CHAMAESYCE HUMISTRATA (Engelm.) Small.
Peronospora Euphorbiae Fuckel.
CHAMAESYCE MACULATA (L.) Small.
Peronospora Euphorbiae Fuckel.
CHAMAESYCE NUTANS (Lag.) Small.
Peronospora Euphorbiae Fuckel.
CHAMAESYCE SERPENS (H.B.K.) Small.
Peronospora Euphorbiae Fuckel.
CHAMAESYCE SERPYLLIFOLIA (Pers.) Small.
Peronospora Euphorbiae Fuckel.
CHAMAESYCE STICTOSPORA (Engelm.) Small.
Peronospora Euphorbiae Fuckel.
EUPHORBIA; see *Chamaesyce*.
EUPHORBIA HIRSUTA Engelm.; error for *E. hirtula* Engelm.
EUPHORBIA HYPERICIFOLIA A. Gray; see *Chamaesyce nutans* (Lag.) Small.
EUPHORBIA PRESLII Guss.; see *Chamaesyce nutans* (Lag.) Small.

FABACEAE

ASTRAGALUS CANADENSIS L.
Peronospora Trifoliorum de Bary.
ASTRAGALUS LOTIFLORUS Hook.
Peronospora Trifoliorum de Bary.
ASTRAGALUS sp.
Peronospora Trifoliorum de Bary.
MEDICAGO SATIVA L.
Peronospora Trifoliorum de Bary.
PHASEOLUS LUNATUS L.
Phytophthora Phaseoli Thaxter.
PISUM SATIVUM L.
Peronospora Viciae de Bary.
TRIFOLIUM CAROLINIANUM Michx.
Peronospora Trifoliorum de Bary.
TRIFOLIUM sp.
Peronospora Trifoliorum de Bary.
VICIA AMERICANA Muhl.
Peronospora Viciae de Bary.
VICIA AMERICANA LINEARIS S. Wats.; see *V. linearis* (Nutt.) Greene.
VICIA FABA L.
Peronospora Viciae de Bary.
VICIA LINEARIS (Nutt.) Greene.
Peronospora Viciae de Bary.
VICIA SATIVA L.
Peronospora Viciae de Bary.
VICIA sp.
Peronospora Viciae de Bary.

FUMARIACEAE

BICUCULLA CANADENSIS (Goldie) Millsp.
Peronospora Corydalis de Bary.
BICUCULLA CUCULLARIA (L.) Millsp.
Peronospora Corydalis de Bary.
BICUCULLA sp.
Peronospora Corydalis de Bary.
CAPNOIDES AUREUM (Willd.) Kuntze.
Peronospora Corydalis de Bary.
CAPNOIDES SEMPERVIRENS (L.) Borck.
Peronospora Corydalis de Bary.

CAPNOIDES sp.
Peronospora Corydalis de Bary.
CORYDALIS; see *Capnoides.*
CORYDALIS AUREA OCCIDENTALIS Engelm.; see *Capnoides aureum* (Willd.) Kuntze.
CORYDALIS GLAUCA Pursh; see *Capnoides sempervirens* (L.) Borck.
DICENTRA; see *Bicuculla.*

GERANIACEAE

GERANIUM CAROLINIANUM L.
Rhysotheca Geranii (Peck) G. W. Wilson.
GERANIUM DISSECTUM L.
Rhysotheca Geranii (Peck) G. W. Wilson.
GERANIUM MACULATUM L.
Rhysotheca Geranii (Peck) G. W. Wilson.
GERANIUM PUSILLUM Burm. f.
Rhysotheca Geranii (Peck) G. W. Wilson.
GERANIUM RICHARDSONII Fish. & Trautv.
Rhysotheca Geranii (Peck) G. W. Wilson.
GERANIUM ROBERTIANUM L.
Rhysotheca Geranii (Peck) G. W. Wilson.
GERANIUM sp.
Rhysotheca Geranii (Peck) G. W. Wilson.

GROSSULARIACEAE

GROSSULARIA DIVARICATA (Dougl.) Coville & Britton.
Rhysotheca ribicola (Schröt.) G. W. Wilson.
GROSSULARIA OXYACANTHOIDES (L.) Mill.
Rhysotheca ribicola (Schröt.) G. W. Wilson.
GROSSULARIA ROTUNDIFOLIA (Michx.) Coville & Britton.
Rhysotheca ribicola (Schröt.) G. W. Wilson.
RIBES ALBINERVUM Michx.; see *R. triste* Pall.
RIBES DIVARICATUM Dougl.; see *Grossularia divaricata* (Dougl.) Coville & Britton.
RIBES GLANDULOSUM Grauer.
Rhysotheca ribicola (Schröt.) G. W. Wilson.
RIBES HIRTELLUM Michx.; see *Grossularia oxyacanthoides* (L.) Mill.
RIBES OXYACANTHOIDES L.; see *Grossularia oxyacanthoides* (L.) Mill.
RIBES PROSTRATUM L'Hér.; see *R. glandulosum* Grauer.
RIBES ROTUNDIFOLIUM Michx.; see *Grossularia rotundifolia* (Michx.) Coville & Britton.
RIBES RUBRUM SUBGLANDULOSUM Maxim.; see *R. triste* Pall.
RIBES TRISTE Pall.
Rhysotheca ribicola (Schröt.) G. W. Wilson.

HYDROPHYLLACEAE

HYDROPHYLLUM MACROPHYLLUM Nutt.
Peronospora Hydrophylli Waite.
HYDROPHYLLUM VIRGINICUM L.
Peronospora Hydrophylli Waite.

LAMIACEAE

AGASTACHE NEPETOIDES (L.) Kuntze.
Peronospora Lophanthi Farlow.
AGASTACHE SCROPHULARIAEFOLIA (Willd.) Kuntze.
Peronospora Lophanthi Farlow.
HEDEOMA HISPIDA Pursh.
Peronospora Hedeomae K. & S.
LAMIUM AMPLEXICAULE L.
Peronospora Lamii A. Braun.
LOPHANTHUS; see *Agastache.*
SALVIA LANCEOLATA Willd.
Peronospora Lamii A. Braun.

LIMNANTHACEAE

FLOERKEA PROSERPINACOIDES Willd.
Peronospora Floerkeae Kellerm.

LINACEAE

LINUM SULCATUM Ridd.
Peronospora Lini Schröt.

ONAGRACEAE

GAURA PARVIFLORA Dougl.
Peronospora Arthurii Farl.
HARTMANNIA SPECIOSA (Nutt.) Small.
Peronospora Arthurii Farl.
MEGAPTERIUM MISSOURIENSE (Sims) Spach.
Peronospora Arthurii Farl.
OENOTHERA BIENNIS L.; see *Onagra biennis* (L.) Scop.
OENOTHERA LACINIATA Hill.
Peronospora Arthurii Farl.
OENOTHERA MISSOURIENSIS Sims; see *Megapterium missouriense* Spach.
OENOTHERA SINUATA L.; see *O. laciniata* Hill.
OENOTHERA SPECIOSA Nutt.; see *Hartmannia speciosa* (Nutt.) Small.
OENOTHERA sp.
Peronospora Arthurii Farl.
ONAGRA BIENNIS (L.) Scop.
Peronospora Arthurii Farl.

PAPAVERACEAE

ARGEMONE PLATYCERAS Coulter.
Peronospora arborescens (Berk.) de Bary.

PLANTAGINACEAE

PLANTAGO ARISTATA Michx.
Peronospora plantaginis Underw.
PLANTAGO LANCEOLATA L.
Peronospora alta Fuckel.
PLANTAGO MAJOR L.
Peronospora alta Fuckel.
PLANTAGO PATAGONICA ARISTATA (Michx.) A. Gray; see *P. aristata* Michx.
PLANTAGO RUGELII Decaisne.
Peronospora alta Fuckel.
PLANTAGO VIRGINICA L.
Peronospora alta Fuckel.
PLANTAGO sp.
Peronospora alta Fuckel.

POACEAE.

CHAETOCHLOA GLAUCA (L.) Scribn.
Sclerospora graminicola (Sacc.) Schröt.
CHAETOCHLOA ITALICA (L.) Scribn.
Sclerospora graminicola (Sacc.) Schröt.
CHAETOCHLOA VIRIDIS (L.) Scribn.
Sclerospora graminicola (Sacc.) Schröt.
CHAMAERAPHIS; see *Chaetochloa.*
CHLORIS ELEGANS H.B.K.
Sclerospora Farlowii Griff.
IXOPHORUS; see *Chaetochloa.*
SETARIA; see *Chaetochloa.*

POLEMONIACEAE

GILIA sp.
Peronospora Giliae E. & E.
PHLOX DIVARICATA L.
Peronospora phlogina D. & H.

POLYGONACEAE

POLYGONUM AVICULARE L.
Peronospora Polygoni Thümen.
POLYGONUM DUMETORUM L.; see *Tiniaria dumetorum* (L.) Opiz.
POLYGONUM DUMETORUM SCANDENS (L.) A. Gray; see *Tiniaria scandens* (L.) Small.
TINIARIA DUMETORUM (L.) Opiz.
Peronospora Polygoni Thümen.
TINIARIA SCANDENS (L.) Small.
Peronospora Polygoni Thümen.

PORTULACACEAE

CALANDRINIA MENZIESII Hook.
Peronospora Claytoniae Farl.
CLAYTONIA PERFOLIATA Donn; see *Montia perfoliata* (Donn) Howell.
CLAYTONIA VIRGINICA L.
Peronospora Claytoniae Farl.
MONTIA PERFOLIATA (Donn) Howell.
Peronospora Claytoniae Farl.
PORTULACA OLERACEA L.
Albugo Portulacae (DC.) Kuntze.

PRIMULACEAE

ANDROSACE OFFICINALIS Pursh.
Peronospora candida Fuckel.

RANUNCULACEAE

ANEMONE ACUTILOBA Laws.; see *Hepatica acutiloba* (Pursh) Britton.
ANEMONE CANADENSIS L.
Plasmopara pygmaea (Unger) Schröt.
ANEMONE DICHOTOMA L.; see *A. canadensis* L.
ANEMONE MULTIFIDA Poir.
Plasmopara pygmaea (Unger) Schröt.
ANEMONE NEMOROSA L.; see *A. quinquefolia* L.
ANEMONE PENNSYLVANICA L.; see *A. canadensis* L.
ANEMONE QUINQUEFOLIA L.
Plasmopara pygmaea (Unger) Schröt.
ANEMONE VIRGINIANA L.
Plasmopara pygmaea (Unger) Schröt.
ANEMONE sp.
Plasmopara pygmaea (Unger) Schröt.
HEPATICA ACUTA (Pursh) Britton.
Plasmopara pygmaea (Unger) Schröt.
HEPATICA ACUTILOBA DC.; see *H. acuta* (Pursh) Britton.
HEPATICA HEPATICA (L.) Karst.
Plasmopara pygmaea (Unger) Schröt.
HEPATICA TRILOBA Chaix; see *H. Hepatica* (L.) Karst.
RANUNCULUS ABORTIVUS L.
Peronospora Ficariae Tul.
RANUNCULUS ACRIS Tul.
Peronospora Ficariae Tul.
RANUNCULUS BULBOSUS L.
Peronospora Ficariae Tul.
RANUNCULUS FASCICULARIS Muhl.
Peronospora Ficariae Tul.
RANUNCULUS PENNSYLVANICUS L. f.
Peronospora Ficariae Tul.
RANUNCULUS RECURVATUS Poir.
Peronospora Ficariae Tul.
RANUNCULUS REPENS L.
Peronospora Ficariae Tul.
RANUNCULUS SEPTENTRIONALIS Poir.
Peronospora Ficariae Tul.
RANUNCULUS sp.
Peronospora Ficariae Tul.
THALICTRUM PURPURASCENS L.
Phytophthora Thalictri Wilson & Davis.

ROSACEAE

AGRIMONIA EUPATORIA L.; see *A. mollis* (T. & G.) Britton.
AGRIMONIA MOLLIS (T. & G.) Britton.
Peronospora Potentillae de Bary.
GEUM ALBUM Gmel.; see *G. canadense* Jacq.
GEUM CANADENSE Jacq.
Peronospora Potentillae de Bary.

GEUM MACROPHYLLUM Willd.
Peronospora Potentillae de Bary.
GEUM RIVALE L.
Peronospora Potentillae de Bary.
POTENTILLA GRANDIFLORA L.
Peronospora Potentillae de Bary.
POTENTILLA MONSPELIENSIS L.
Peronospora Potentillae de Bary.
POTENTILLA NORVEGICA L.; see *P. monspeliensis* L.
POTENTILLA NEPALENSIS Hook.
Peronospora Potentillae de Bary.
POTENTILLA sp.
Peronospora Potentillae de Bary.
ROSA CALIFORNICA Schlecht.
Peronospora sparsa Berk.
ROSA sp.
Peronospora sparsa Berk.
RUBUS BAILEYANUS Britton.
Peronospora Rubi Rabenh.
RUBUS CANADENSIS L.; see *R. procumbens* Muhl.
RUBUS NIGROBACCUS Bailey.
Peronospora Rubi Rabenh.
RUBUS OCCIDENTALIS L.
Peronospora Rubi Rabenh.
RUBUS PROCUMBENS Muhl.
Peronospora Rubi Rabenh.
RUBUS STRIGOSUS Michx.
Peronospora Rubi Rabenh.
RUBUS VILLOSUS Ait.; see *R. nigrobaccus* Bailey.
RUBUS VILLOSUS HUMIFUSUS T. & G.; see *R. Baileyanus* Britton.
RUBUS sp.
Peronospora Rubi Rabenh.

RUBIACEAE

GALIUM APARINE L.
Peronospora calotheca de Bary.
GALIUM BOREALE L.
Peronospora calotheca de Bary.
GALIUM LANCEOLATUM Torr.
Peronospora calotheca de Bary.
GALIUM TRIFLORUM Michx.
Peronospora calotheca de Bary.
GALIUM sp.
Peronospora calotheca de Bary.
HOUSTONIA MINOR (Michx.) Britton.
Peronospora Seymourii Burrill.
HOUSTONIA PATENS Ell.; see *H. minor* (Michx.) Britton.

SAXIFRAGACEAE

WHIPPLEA MODESTA Torr.
Peronospora Whippleae E. & E.

SCROPHULARIACEAE

LINARIA CANADENSIS (L.) Dumont.
Peronospora Linariae Fuckel.
SCROPHULARIA CALIFORNICA Cham.
Peronospora sordida B. & Br.
SCROPHULARIA MARILANDICA L.
Peronospora sordida B. & Br.
SCROPHULARIA NODOSA L.; see *S. marilandica* L.
SCROPHULARIA NODOSA MARILANDICA A. Gray; see *S. marilandica* L.
SCROPHULARIA sp.
Peronospora sordida B. & Br.
VERONICA ALPINA L.; see *V. Wormskioldii* R. & S.
VERONICA ANAGALLIS L.; see *V. Anagallis-aquatica* L.
VERONICA ANAGALLIS-AQUATICA L.
Peronospora grisea Unger.
VERONICA ARVENSIS L.
Peronospora grisea Unger.
VERONICA PEREGRINA L.
Peronospora grisea Unger.
VERONICA WORMSKIOLDII R. & S.
Peronospora grisea Unger.
VERONICA sp.
Peronospora grisea Unger.

SOLANACEAE

LYCOPERSICON LYCOPERSICON (L.) Karst.
Phytophthora infestans (Mont.) de Bary.
NICOTIANA GLAUCA Graham.
Peronospora Nicotianae Speg.
SOLANUM LYCOPERSICON L.; see *Lycopersicon Lycopersicon* (L.) Karst.
SOLANUM TUBEROSUM L.
Phytophthora infestans (Mont.) de Bary.

STERCULIACEAE

THEOBROMA CACAO L.
Phytophthora Cactorum (C. & L.) Schröt.

ULMACEAE

CELTIS OCCIDENTALIS L.
Pseudoperonospora Celtidis (Waite) G. W. Wilson.

URTICACEAE

LAPORTEA CANADENSIS Gaud.; see *Urticastrum divaricatum* (L.) Kuntze.
PARIETARIA PENNSYLVANICA Muhl.
Rhysotheca illinoiensis Farlow.
URTICA GRACILIS Ait.
Peronospora Urticae de Bary.
URTICA sp.
Peronospora Urticae de Bary.
URTICASTRUM DIVARICATUM (L.) Kuntze.
Peronospora Urticae de Bary.

VIOLACEAE

VIOLA ODORATA L.
Peronospora Violae de Bary.

VIOLA RAFINESQUII Greene.
Peronospora Violae de Bary.

VIOLA TENELLA Muhl.; see *V. Rafinesquii* Greene.

VIOLA TRICOLOR L.
Peronospora Violae de Bary.

VIOLA TRICOLOR ARVENSIS Hook.; see *V. Rafinesquii* Greene.

VITACEAE

AMPELOPSIS QUINQUEFOLIA (L.) Michx.; see *Parthenocissus quinquefolia* (L.) Planch.

AMPELOPSIS RICHII; error for *A. Veitchii*.

AMPELOPSIS VEITCHII; horticultural name for *Parthenocissus tricuspidata* (Sieb. & Zucc.) Planch.

PARTHENOCISSUS QUINQUEFOLIA (L.) Planch.
Rhysotheca viticola (B. & C.) G. W. Wilson.

PARTHENOCISSUS TRICUSPIDATA (Sieb. & Zucc.) Planch.
Rhysotheca viticola (B. & C.) G. W. Wilson.

VITIS AESTIVALIS Michx.
Rhysotheca viticola (B. & C.) G. W. Wilson.

VITIS BICOLOR LeConte.
Rhysotheca viticola (B. & C.) G. W. Wilson.

VITIS CALIFORNICA Hook. & Arn.
Rhysotheca viticola (B. & C.) G. W. Wilson.

VITIS CINEREA Engelm.
Rhysotheca viticola (B. & C.) G. W. Wilson.

VITIS CORDIFOLIA Michx.
Rhysotheca viticola (B. & C.) G. W. Wilson.

VITIS LABRUSCA L.
Rhysotheca viticola (B. & C.) G. W. Wilson.

VITIS RIPARIA L.; see *V. vulpina* L.

VITIS ROTUNDIFOLIA Michx.
Rhysotheca viticola (B. & C.) G. W. Wilson.

VITIS VINIFERA L.
Rhysotheca viticola (B. & C.) G. W. Wilson.

VITIS VULPINA L.
Rhysotheca viticola (B. & C.) G. W. Wilson.

VITIS sp.
Rhysotheca viticola (B. & C.) G. W. Wilson.

NEW YORK BOTANICAL GARDEN.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1908)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

This Index is reprinted monthly on cards, and furnished in this form to subscribers, at the rate of one cent for each card. Selections of cards are not permitted; each subscriber must take all cards published during the term of his subscription. Correspondence relating to the card-issue should be addressed to the Treasurer of the Torrey Botanical Club.

Atkinson, G. F. A parasitic alga, *Rhodochytrium Spilanthidis* Lagerheim, in North America. Bot. Gaz. **46**: 299–301. 17 O 1908.

Bailey, W. W. Tricky plants. Am. Bot. **14**: 67, 68. [O] 1908.

Ball, O. M. Formation of adventitious roots in the umbrella China tree. Bot. Gaz. **46**: 303, 304. *f. 1, 2.* 17 O 1908.

Becker, W. *Viola gracillima* var. *incisa* W. Becker, nov. var. Repert. Nov. Spec. **5**: 46. 15 F 1908.
Native in Brazil.

Berger, A. *Cereus Beneckii* Ehrenb. Monats. Kakteenk. **18**: 134, 137, 138. 15 S 1908.

Berry, E. W. A Miocene cypress swamp. Torreya **8**: 233–235. 22 O 1908.

Berry, E. W. A new cretaceous *Bauhinia*. Torreya **8**: 218, 219. 26 S 1908.
Bauhinia marylandica.

Børgesen, F. The species of Avrainvilleas hitherto found on the shores of the Danish West Indies. Vid. Medd. Naturh. For. Kjöbenhavn 1908: 27–44. *pl. 3.* Je 1908.

Bouly de Lesdain, M. Notes lichénologiques — VIII. Bull. Soc. Bot. France **55**: 420–424. 11 Au 1908.
Includes *Lecidea Stanaaerti* sp. nov., native in Peru.

Broadhurst, J. Nomenclature. Torreya **8**: 236, 237. 22 O 1908.

Broadway, W. E. The orchids of Grenada, West Indies. Gard. Chron. III. **44**: 228, 229. 26 S 1908.

Brooks, C. The fruit spot of apples. Bull. Torrey Club **35**: 423–456. *pl. 29–35 + f. 1, 2.* 29 S 1908.
Includes *Cylindrosporium Pomi* sp. nov.

Burlingame, L. L. The staminate cone and male gametophyte of *Podocarpus*. Bot. Gaz. **46**: 161–178. *pl. 8, 9 + f. A, B, 1.* 22 S 1908.

Clute, W. N. Rare forms of ferns — VII. A slender-leaved *Cystopteris*. Fern Bull. **16**: 75–77. [S] 1908. [Illust.]

Cockerell, T. D. A. A new name for *Euphorbia montana*. Muhlenbergia **4**: 56. 26 S 1908.
Tithymalus philorus.

Cockerell, T. D. A. Some aspects of the Florissant expeditions of 1908. Am. Nat. **42**: 569–581. *f. 1–12.* 30 S 1908.

Collins, F. S. Notes on algae — IX. Rhodora **10**: 155–164. 30 S 1908.
Includes *Pilinia endophytica* sp. nov., endophytic in *Ralfsia Borneti.*

Cook, O. F. The spreading of Mendelian characters. Science II. **28**: 519, 520. 16 O 1908.

Crocker, W., & Knight, L. I. Effect of illuminating gas and ethylene upon flowering carnations. Bot. Gaz. **46**: 259–276. *f. 1–4.* 17 O 1908.

Déribéré-Desgardes, & Renaudet, G. Sur la scyphogénie de l'*Heliamphora nutans* Benth. Bull. Soc. Bot. France **55**: 443–445. 11 Au 1908. [Illust.]

Dietel, P. Einige neue Uredineen aus Südamerika — II. Ann. Myc. **6**: 94–98. 31 My 1908.
Includes ten new species.

Dode, L. A. *Carya Diguetii* spec. nov. Bull. Soc. Bot. France **55**: 470, 471. 11 Au 1908.
Native of Mexico.

Dorety, H. A. The seedling of *Ceratozamia*. Bot. Gaz. **46**: 203–220. *pl. 12–16 + f. 1, 2.* 22 S 1908.

Eckerson, S. H. The number and size of the stomata. Bot. Gaz. **46**: 221–224. 22 S 1908.

Eichlam, F. Mitteilungen aus Zentral-Amerika. Monats. Kakteenk. **18**: 138–143. 15 S 1908.

Elmer, A. D. E. Some interesting *Lauraceae*. Leaflets Philippine Bot. **2**: 375–384. 12 S 1908.

Engerrand, G. Les phénomènes de la télégonie et de la xénie, sont-ils inexplicables? Mem. y Rev. Soc. Cien. Antonio Alzate **26**: 285–295. F 1908.

Fernald, M. L. Preliminary lists of New England plants — XXII. *Najadaceae*. Rhodora **10**: 168–172. 30 S 1908.

Foslie, M. Algologiske notiser — V. Kgl. Norske. Vid. Selsk. Skr. 1908[7]: 1–20. 1908.

Greene, E. L. Novitates boreali-americanae — I. Repert. Nov. Spec. **5**: 45, 46. 15 F 1908; — II. 241–244. 20 Au 1908.
Include new species in *Antennaria*, *Arabis* (11), *Convallaria* (2), and *Rhus* (3).

Gürke, M. *Cereus Spegazzinii* Web. und *C. Anisitsii* K. Schum. Monats. Kakteenk. **18**: 129–133. 15 S 1908.

Hackel, E. *Gramineae* novae — III. Repert. Nov. Spec. **5**: 1. 20 Ja 1908.
Paspalum Usteri sp. nov. from Brazil.

Harvey, L. H. Floral succession in the prairie-grass formation of southeastern South Dakota. Bot. Gaz. **46**: 277–298. 17 O 1908.

Hemsley, W. B. *Lewisia Cotyledon*. Curt. Bot. Mag. **4**: *pl. 8220*. O 1908.

Hennings, P. *Fungi* paraenses—III. Hedwigia **48**: 101–117. 5 S 1908.
Includes many new species in numerous families.

Hennings, P. *Fungi* s.-paulenses — IV. a cl. Puttemans collecti. Hedwigia **48**: 1–20. 5 S 1908.
Includes many new species in numerous families.

Holm, T. *Sisyrinchium*: anatomical studies of North American species. Bot. Gaz. **46**: 179–192. *pl. 10–11A*. 22 S 1908.

House, H. D. Synopsis of the Californian species of *Convolvulus*. Muhlenbergia **4**: 49–56. 26 S 1908.
Includes *C. cyclostegius*, and *C. illecebrosus* spp. nov.

Hunt, R. The loco-weed disease. Science II. **28**: 570, 571. 23 O 1908.

Hurst, L. E. Studying the wild flowers. Am. Bot. **14**: 69. [O] 1908.

Jackson, H. S. Development of disease-resistant varieties of plants. Trans. Mass. Hort. Soc. **1908**: 123–136. 1908.

Jeffrey, E. C. Are there foliar gaps in the *Lycopsida*? Bot. Gaz. **46**: 241–258. *pl. 17, 18*. 17 O 1908.

Knowlton, C. H. A trip to Killingly, Connecticut. Rhodora **10**: 164–167. 30 S 1908.

Kraemer, H. Botany and pharmacognosy. Ed. 3. i–viii. + 1–850. *f. 1–328.* Philadelphia and London. 1908.

Kraemer, H. Some of the distinguishing morphological characters of *Belladonna* and *Scopolia*. Am. Jour. Pharm. **80**: 459–464. *f. 1–3.* O 1908.

Léveillé, H. Decades plantarum novarum — IV, V. Repert. Nov. Spec. **5**: 8–12. 20 Ja 1908; — VII. **5**: 194, 195. 1 Jl 1908.
Includes 4 new species of *Epilobium* from northern North America.

Léveillé, H. *Epilobia* nova. Repert. Nov. Spec. **5**: 98, 99. 15 My 1908.
Includes 3 new species from North America.

Loew, O. Note on balanced solutions. Bot. Gaz. **46**: 302, 303. 17 O 1908.

Maire, R. Champignons de Sao Paulo (Brésil) — I. Ann. Myc. **6**: 144–153. *pl. 1 + f. 1–7.* 31 My 1908.
Includes *Maireella* Syd. gen. nov., and 7 new species.

Maire, R. Les suçoirs des *Meliola* et des *Asterina*. Ann. Myc. **6**: 124–128. *f. 1–4.* 31 My 1908.

Malme, G. O. A. *Xyrides* austro-americanae novae — II. Repert. Nov. Spec. **5**: 101–103. 15 My 1908.
Includes 3 new species from Brazil.

Merrill, E. D. New or noteworthy Philippine plants — VI. Philippine Jour. Sci. **3**: 219–267. Au 1908.

Merrill, E. D. New Philippine plants from the collections of Mary Strong Clemens — I. Philippine Jour. Sci. **3**: 129–165. Jl 1908.

Moore, E. Abnormalities in the radish, clover, and ash. Torreya **8**: 220. 26 S 1908.

Murrill, W. A. *Boleti* from western North Carolina. Torreya **8**: 209–217. 26 S 1908.
Includes *B. Vanderbiltianus* sp. nov.

Murrill, W. A. Notes on the life and work of Charles C. Frost. Torreya **8**: 197–200. 1 S 1908.

Osborne, T. B. Our present knowledge of plant proteins. Science II. **28**: 417–427. 2 O 1908.

Parish, S. B. Fremont in southern California. Muhlenbergia **4**: 57–62. 26 S 1908.

Pax, F. Einige neue Pflanzen der bolivianischen Flora. Repert. Nov. Spec. **5**: 225–227. 20 Au 1908.
Includes new species in *Apopetalum* (2), a new genus of the *Rosaceae*, *Gamardia*, *Cotoneaster*, *Acalypha* (2), and *Buddleia*.

Pease, C. E. Notes on the Acadian flora. Am. Bot. **14**: 70, 71. [O] 1908.

Pease, A. S. Four introduced plants at Cambridge, Mass. Rhodora **10**: 167. 1908.

Peirce, G. J. A new respiration calorimeter. Bot. Gaz. **46**: 193–202. 22 S 1908.

Pittier, H. The Mexican and Central American species of *Sapium*. Contr. U. S. Nat. Herb. **12**: 159–169. *pl. 10–17 + f. 7–10.* 6 O 1908.
Includes 6 new species.

Reade, J. M. Preliminary notes on some species of *Sclerotinia*. Ann. Myc. **6**: 109–115. 31 My 1908.
Includes 4 new species.

Reed, G. M. Infection experiments with *Erysiphe Cichoracearum* DC. Bull. Univ. Wisconsin, Science Series **3**: 337–416. 1908.

Rehm, H. *Ascomycetes* exs. fasc. 41. Ann. Myc. **6**: 116–124. 31 My 1908.
Includes 6 new species.

Rich, W. P. City botanizing. Rhodora **10**: 149–155. 30 S 1908.

Rick, J. *Fungi* austro-americani — fasc. IX u. X. Ann. Myc. **6**: 105–108. 31 My 1908.
Includes *Fusicoccum Kesslerianum* sp. nov.

Robinson, C. B. Alabastra philippinensia — II. Philippine Jour. Sci. **3**: 175–218. Au 1908.

Robinson, B. L., & Fernald, M. L. Gray's new manual of botany. A handbook of the flowering plants and ferns of the central and northeastern United States and adjacent Canada. Ed. 7. 1–926. *f. 1–1036.* [18 S] 1908.

Romine, H. R. A teratological note on timothy. Torreya **8**: 220. 26 S 1908.

Rosen, J., & Heller, C. The absorptive power of a cultivated soil. Bot. Gaz. **46**: 224–229. *f. 1–3.* 22 S 1908.

Rosenstock, E. *Filices* novae — III. Repert. Nov. Spec. **5**: 13–17. 20 Ja 1908
Includes 2 new species in *Polypodium* from Ecuador.

Rosenstock, E. *Filices* novae a Dre. O. Buchtien in Bolivia collectae. Repert. Nov. Spec. **5**: 228–239. 20 Au 1908.
Includes new species in *Gleichenia* (2), *Hymenophyllum*, *Adiantum* (2), *Blechnum*, *Diplazium*, *Dryopteris* (2), *Polypodium* (4), *Notochlaena*, and *Lycopodium*.

Rothrock, J. T. Laurel oak, shingle oak (*Quercus imbricaria* Michx.). Forest Leaves **11**: 168. O 1908. [Illust.]

Rydberg, P. A. Notes on *Philotria* Raf. Bull. Torrey Club **35**: 457–465. 29 S 1908.
Includes *P. linearis* sp. nov.

Sack, J. Lijst van eenige planten, die in Suriname als geneeskrachtig worden beschouwd met opgave van de ziekten tegen welke zij worden aangewend. Insp. Landb. West-Indië Bull. **13**: 1–23. S 1908.

Schulz, O. E. Ein neues *Citharexylum* (*C. Urbanii*) aus Jamaica. Repert. Nov. Spec. **5**: 193, 194. 1 Jl 1908.

Setchell, W. A. Juvenile substitutes for smoking tobacco. Am. Nat. **42**: 682–684. 29 O 1908.

Stone, G. E. Some simple physiological apparatus. Torreya **8**: 242–247. *f. 1–4.* 22 O 1908.

Sutherland, J. C. The occurrence of *Thymus Serpyllum* at Richmond, Que. Ottawa Nat. **22**: 139, 140. O 1908.

Thaxter, R. Contribution toward a monograph of the *Laboulbeniaceae*. Part II. Mem. Am. Acad. Sci. **13**: 217–469. *pl. 28–61.* 1908.
Includes *Kleidiomyces*, *Smeringomyces*, *Symplectromyces*, *Hydrophilomyces*, *Rhynchophoromyces*, and *Autoicomyces*, genera nova, and 4 new American species in other genera.

Van Hall, C. J. J., & Drost, A. W. Les balais de sorcière du cacaoyer provoqués par *Colletotrichum luxificum* n. sp. Rec. Trav. Bot. Néerlandais **4**: 243–321. *pl. 9–25.* 1908.

Wadmond, S. C. *Arceuthobium* in Wisconsin. Am. Bot. **14**: 72, 73. [O] 1908.

Wakeman, N. Phytochemical notes — 69. Quantitative determination of oxidase in the leaves of *Monarda fistulosa*. Pharm. Rev. **26**: 314, 315. O 1908.

Williams, R. S. Report on botanical explorations in Panama. Jour. N. Y. Bot. Gard. **11**: 149–158. *f. 23–28.* S 1908.

Zahlbruckner, A. Neue Flechten — IV. Ann. Myc. **6**: 129–134. 31 My 1908.
Includes 5 new American species.

Zederbauer, C. The light requirements of forest trees and the method of measuring light. Forest. Quart. **6**: 255–262. S 1908.
[Translated and reprinted from the Centralb. gesammt. Forstw. 1907: 325–330.]

BOLETUS FERRUGINEUS Frost ($\times \frac{2}{3}$)

BOLETUS INNIXUS Frost (×½)

BOLETUS PALLIDUS Frost ( )

BOLETUS ROXANAE Frost ($\times \frac{3}{8}$)

BOLETUS RUSSELLII Frost ($\times \frac{2}{3}$)

THE BRYOLOGIST

WITH THE JANUARY, 1908, NUMBER BEGINS ITS

ELEVENTH YEAR AND VOLUME

It is a 16–20 page bi-monthly devoted to the study of the Mosses, Hepatics, and Lichens. It is fully illustrated with new, original, and artistic drawings and half-tones. It is indispensable to the working bryologist, professional as well as amateur. Send for sample copy. Subscription price $1.00 a year.

Address, MRS. ANNIE MORRILL SMITH, 78 Orange Street, Brooklyn, N. Y.

INDEX TO

AMERICAN BOTANICAL LITERATURE

This Index, printed each month in the BULLETIN, is reissued on library catalogue cards; these are furnished to subscribers at the rate of one cent for each card.

Subscriptions to the card-issue may be addressed to the Treasurer of the Torrey Botanical Club,

WILLIAM MANSFIELD, COLLEGE OF PHARMACY, 115 W. 68th St., N. Y. City.

Beginning with January, 1903, the Index has also been reprinted on paper, on one side only, and can be furnished in that form at the rate of $3.00 a year.

North American Flora

THIS work is designed to present descriptions of all plants growing independently of cultivation, in North America, here taken to include Greenland, Central America, the Republic of Panama, and the West Indies, except Trinidad, Tobago, and Curaçao and other islands off the north coast of Venezula, whose flora is essentially South American.

It will be published in parts at irregular intervals by the New York Botanical Garden through the aid of the income of the David Lydig Fund bequeathed by Charles P. Daly.

It is planned to issue parts as rapidly as they can be prepared, the extent of the work making it possible to commence publication at any number of points. The completed work will form a series of volumes with the following sequence:

Volume 1. Mycetozoa, Schizophyta, Diatomaceae.
Volume 2 to 10. Fungi.
Volumes 11 to 13. Algae.
Volumes 14 and 15. Bryophyta.
Volume 16. Pteridophyta and Gymnospermae.
Volumes 17 to 19. Monocotyledones.
Volumes 20 to 30. Dicotyledones.

The preparation of the work has been referred by the Scientific Directors of the Garden to a committee consisting of Dr. N. L. Britton, Dr. W. A. Murrill and Dr. J. H. Barnhart.

Professor George F. Atkinson, of Cornell University, Professors Charles R. Barnes and John M. Coulter, of the University of Chicago, Mr. Frederick V. Coville, of the United States Department of Agriculture, Professor Edward L. Greene, of the United States National Museum, Professor Byron D. Halsted, of Rutgers College, and Professor William Trelease, of the Missouri Botanical Garden, have consented to act as an advisory committee.

Vol. 7, Part 1, Ustilaginales, including Ustilaginaceae and Tilletiaceae, by G. P. Clinton, was issued Oct. 4, 1906. Vol. 7, Part 2, Coleosporiaceae, Uredinaceae, and Aecidiaceae (pars), of the Uredinales, by J. C. Arthur, was issued March 6, 1907. Vol. 9, Parts 1 and 2, Polyporaceae, by W. A. Murrill, were issued Dec. 19, 1907, and March 12, 1908. Vol. 22, Part 1, including Podostemonaceae by George V. Nash, Crassulaceae by N. L. Britton and J. N. Rose, and Penthoraceae and Parnassiaceae by P. A. Rydberg, was issued May 22, 1905. Vol. 22, Part 2, including Saxifragaceae and Hydrangeaceae by J. K. Small and P. A. Rydberg, Cunoniaceae, Iteaceae, and Hamamelidaceae by N. L. Britton, Pterostemonaceae by J. K. Small, Altingiaceae by Percy Wilson, and Phyllonomaceae by H. H. Rusby, was issued Dec. 18, 1905. Vol. 22, Part 3, Grossulariaceae by F. V. Coville and N. L. Britton, Platanaceae by H. A. Gleason, Crossosomataceae by J. K. Small, Connaraceae by N. L. Britton, Calycanthaceae by C. L. Pollard, and Rosaceae (pars) by P. A. Rydberg, was issued June 12, 1908. Vol. 25, Part 1, including Geraniaceae by L. T. Hanks and J. K. Small, Oxalidaceae and Linaceae by J. K. Small, and Erythroxylaceae by N. L. Britton, was issued Aug. 24, 1907.

The subscription price is fixed at $1.50 for each part; it is expected that four or five parts will be required for each volume. A limited number of separate parts will be sold at $2.00 each. Address

THE NEW YORK BOTANICAL GARDEN
BRONX PARK, NEW YORK CITY

PUBLICATIONS BY OFFICERS AND STUDENTS OF THE DEPARTMENT OF BOTANY, COLUMBIA UNIVERSITY

1. MEMOIRS OF THE DEPARTMENT:

Vol. 1. A Monograph of the North American Species of the Genus *Polygonum* (1895). By John Kunkel Small, Fellow in Botany, 1893–1895; Curator of the Herbarium, 1895–1898.

Quarto, 178 pages, 84 plates. Price $6.00.

Vol. 2. A Monograph of the North American Potentilleae (1898). By Per Axel Rydberg, Fellow in Botany, 1896–7.

Quarto, 224 pages, 112 plates. Price $6.00.

2. CONTRIBUTIONS FROM THE DEPARTMENT:

Vol. 1. Nos. 1–25. 1886–1892. Price $5.00.
Vol. 2. Nos. 26–50. 1892–1894. Price $5.00.
Vol. 3. Nos. 51–75. 1894–1895. Price $5.00.
Vol. 4. Nos. 76–100. 1895–1896. Price $5.00.
Vol. 5. Nos. 101–125. 1896–1897. Price $5.00.
Vol. 6. Nos. 126–150. 1897–1898. Price $5.00.
Vol. 7. Nos. 151–175. 1898–1901. Price $5.00.
Vol. 8. Nos. 176–200. 1901–1902. Price $5.00.
Vol. 9. Nos. 201–. 1903–(current).

List of separate numbers available on application.

3. A Text-book of General Lichenology (1896). By Albert Schneider, Fellow in Botany, 1895–1896.

Octavo, 230 pages, 76 plates. Price $4.25 (cloth); $3.80 (paper). Published by Willard N. Clute & Co. Binghamton, N. Y.

The Department invites propositions relative to exchanges of herbarium material for any of the above named publications. Address Dr. Carlton C. Curtis, Columbia University, N. Y. City.

4. An Illustrated Flora of the Northern United States, Canada, and the British Possessions from Newfoundland to the Parallel of the Southern Boundary of Virginia, and from the Atlantic Ocean westward to the 102d Meridian (1896–1898). By Nathaniel Lord Britton, Professor of Botany, 1891–1896; Emeritus Professor 1896–, and Hon. Addison Brown.

Three volumes, royal octavo. Vol. 1, 612 pages; Vol. 2, 642 pages; Vol. 3, 588 pages; 4162 figures in the text, illustrating every species described.

Published by Charles Scribner's Sons, New York. Price, in cloth, $9.00 for the three volumes; with the indexes and keys bound separately, $10.00.

5. Our Native Ferns and their Allies. (Sixth Edition) 1900. By Lucien Marcus Underwood, Professor of Botany, 1896–1907.

Duodecimo, 158 pages, 35 figures. Published by Henry Holt & Co., New York. Price, $1.00.

6. Moulds, Mildews, and Mushrooms. By Lucien Marcus Underwood, Professor of Botany, 1896–1907.

Duodecimo, 236 pages, 10 plates. Published by Henry Holt & Co. Price $1.50.

7. Nature and Development of Plants (1907). By Carlton Clarence Curtis, Assistant in Botany, 1892–1895; Tutor in Botany, 1895–1906; Instructor in Botany, 1906–.

Octavo, 471 pages; 342 illustrations. Published by Henry Holt & Co., New York. Price $2.50.

ESTABLISHED 1851

EIMER & AMEND

205–211 Third Ave.,
Corner 18th Street

NEW YORK

MANUFACTURERS AND IMPORTERS OF

Chemicals and Chemical Apparatus

Our Specialties

MICROSCOPES
and
ACCESSORIES

MICROTOMES

BALANCES
and
WEIGHTS

Sole Agents for

C. A. F.
KAHLBAUM'S
C. P. Chemicals
and Reagents

CARL
SCHLEICHER
& SCHÜLL'S
C. P. Filters

SCHOTT &
GENOSSEN'S
Famous Laboratory Glassware

And for many other renowned European houses in our line.

COMPLETE LINE OF

Bacteriological Apparatus

WE HANDLE

EVERYTHING NEEDED FOR A LABORATORY

Inspection of premises cordially invited.

MEMOIRS OF THE TORREY BOTANICAL CLUB

A series of technical papers on botanical subjects, published at irregular intervals. Price $3.00 a volume. Not offered in exchange.

Vol. 1, No. 1; not furnished separately:

Bailey, Liberty Hyde. Studies of the types of various species of the genus *Carex*. Pages 1–85. 25 My 1889.

Vol. 1, No. 2; not furnished separately:

Martindale, Isaac Comly. Marine algae of the New Jersey coast and adjacent waters of Staten Island. Pages 87–111. 24 Au 1889.

Vol. 1, No. 3; price, 75 cents:

Spruce, Richard. *Hepaticae* Bolivianae, in Andibus Boliviae orientalis, annis 1885–6, a cl. H. H. Rusby lectae. Pages 113–140. 20 Ja 1890.

Vol. 1, No. 4; price, 75 cents:

Sturtevant, Edward Lewis. On seedless fruits. Pages 141–187. 30 My 1890.

Vol. 2, No. 1; not furnished separately:

Halsted, Byron David. Reserve food-materials in buds and surrounding parts. Pages 1–26, *plates 1, 2*. 10 S 1890.

Vol. 2, No. 2; price, 75 cents:

Vail, Anna Murray, & Hollick, Charles Arthur. Contributions to the botany of Virginia. Pages 27–56, *plates 3, 4*. 23 D 1890.

Vol. 2, No. 3; not furnished separately:

Holm, Herman Theodor. Contributions to the knowledge of the germination of some North American plants. Pages 57–108, *plates 5–19*. 15 Ap 1891.

Vol. 2, No. 4; price, 75 cents:

Wheelock, William Efner. The genus *Polygala* in North America. Pages 109–152. 30 D 1891.

Vol. 3, No 1; not furnished separately:

Small, John Kunkel, & Heller, Amos Arthur. Flora of western North Carolina and contiguous territory. Pages 1–39. 20 F 1892.

Vol 3, No. 2; price, $2.00:

Morong, Thomas. The *Naiadaceae* of North America [with illustrations of all the species]. Pages 1–65, *plates 20–74*. 15 Mr 1893.

Vol. 3, No. 3; not furnished separately:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. [Part 1.] Pages 1–67. 28 Ap 1893.

Vol. 4, No. 1; not furnished separately:

Underwood, Lucien Marcus. Index *Hepaticarum*. Part I, Bibliography. Pages 1–91. 10 Je 1893.

Vol. 4, No. 2; not furnished separately:

Small, John Kunkel, & Vail, Anna Murray. Report on the botanical exploration of southwestern Virginia during the season of 1892. Pages 93–201, *plates 75–82*. 18 N 1893–17 Ap 1894.

Vol. 4, No. 3; price, 50 cents:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 2. Pages 203–274. 10 Mr–17 Ap 1895.

Vol. 4, No. 4; price, 50 cents:

Pettit, Anna Stockton. *Arachis hypogaea* L. Pages 275–296, *plates 83–85* 5 Je 1895.

Vol. 4, No. 5; price, 75 cents:

Rydberg, Per Axel. The North American species of *Physalis* and related genera. Pages 297–374. 15 S 1896

Vol. 5; price, $3.00:

List of *Pteridophyta* and *Spermatophyta* growing without cultivation in northeastern North America. Pages 1–377. 4 D 1893–31 D 1894.

Vol. 6, No. 1; price, $1.25:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 3. Pages 1–130. 17 N 1896.

Vol. 6, No. 2; not furnished separately:

Grout, Abel Joel. A revision of the North American *Isotheciaceae* and *Brachythecia*. Pages 131–210. 30 Jl 1897.

Vol. 6, No. 3; price, 50 cents:

Hazen, Tracy Elliot. The life history of *Sphaerella lacustris* (*Haematococcus pluvialis*). Pages 211–246, *plates 86, 87* (*colored*). 8 Je 1899.

Vol. 6, No. 4; price, 50 cents:

Underwood, Lucien Marcus. A review of the genera of ferns proposed prior to 1832. Pages 247–283. 1 D 1899.

Vol. 6, No. 5; price, 25 cents:

Fink, Bruce. Notes on lichen distribution in the upper Mississippi Valley. Pages 285–307. 1 D 1899.

Vol. 7; price, $3.00:

Howe, Marshall Avery. The *Hepaticae* and *Anthocerotes* of California. Pages 1–208, *plates 88–122*. 5 Au 1899.

Vol. 8, No. 1; not furnished separately:

Lloyd, Francis Ernest. The comparative embryology of the *Rubiaceae*. Part I. Pages 1–26, *plates 1–4*. 26 Au 1899. Part II. Pages 27–112, *plates 5–15*. 15 F 1902.

Vol. 8, No. 2; price, $1.00:

Evans, Alexander William. The *Lejeuneae* of the United States and Canada. Pages 113–183, *plates 16–22*. 15 F 1902.

Vol. 8, No. 3; price, 75 cents:

Britton, Elizabeth Gertrude, & Taylor, Alexandrina. The life history of *Vittaria lineata*. Pages 185–211, *plates 23–31*. 30 Au 1902.

Vol. 9; price, $3.00:

Salmon, Ernest Stanley. A monograph of the *Erysiphaceae*. Pages 1–292, *plates 1–9*. 4 O 1900.

Vol. 10; price, $3.00:

Burgess, Edward Sandford. History of Pre-Clusian botany in its relation to *Aster*. Pages i–xii, 1–447. 22 N 1902.

Vol. 11, No. 1; price, $1.75:

Griffiths, David. The North American *Sordariaceae*. Pages 1–134, *plates 1–19*. 30 My 1901.

Vol. 11, No. 2; price, $1.75:

Hazen, Tracy Elliot. The *Ulothricaceae* and *Chaetophoraceae* of the United States. Pages 135–250, *plates 20–42*. 20 O 1902.

Vol. 12, No. 1; price, $1.50:

Northrop, Alice Rich. Flora of New Providence and Andros (Bahama Islands). Pages 1–98, *plates 1–19 + map*. 10 D 1902.

Vol. 12, No. 2; price, $1.00:

Banker, Howard James. A contribution to a revision of the North American *Hydnaceae*. Pages 99–194. 13 Je 1906.

Vol. 12, No. 3; price, 75 cents:

Kupfer, Elsie. Studies in plant regeneration. Pages 195–241. 10 Je 1907.

Vol. 13; price, $3.00:

Burgess, Edward Sandford. Species and variations of Biotian Asters, with discussion of variability in *Aster*. Pages i–xv, 1–419, *plates 1–13*. 15 Mr 1906.

Vol. 14, No. 1; price, $1.25:

Burlingham, Gertrude Simmons. A study of the *Lactariae* of the United States. Pages 1–109, *figures 1–15*. 26 My 1908.

Address: **TORREY BOTANICAL CLUB,**
Columbia University, New York City.

VOL. 35 DECEMBER, 1908 NO. 12

BULLETIN

OF THE

TORREY BOTANICAL CLUB

Editor

MARSHALL AVERY HOWE

Associate Editors

JOHN HENDLEY BARNHART
JEAN BROADHURST
PHILIP DOWELL
ALEXANDER WILLIAM EVANS
TRACY ELLIOT HAZEN
WILLIAM ALPHONSO MURRILL
CHARLES LOUIS POLLARD
HERBERT MAULE RICHARDS

CONTENTS

Studies of West Indian plants—II. . . . NATHANIEL LORD BRITTON 561
An analogy between the development of the plates of crinoids and the leaves of Sassafras . . . . . EDWIN W. HUMPHREYS 571
North Dakota slime-moulds . . . . . FRED J. SEAVER 577
Two imperfectly known species of Crataegus. FRANCIS RAMALEY and G. S. DODDS 581
INDEX TO AMERICAN BOTANICAL LITERATURE. 585
INDEX TO VOLUME 35 593

PUBLISHED FOR THE CLUB

THE NEW ERA PRINTING COMPANY
LANCASTER, PA.

THE TORREY BOTANICAL CLUB

President,

HENRY H. RUSBY, M.D.

Vice-Presidents,

EDWARD S. BURGESS, PH.D. JOHN HENDLEY BARNHART, A.M., M.D.

Recording Secretary,

PERCY WILSON.

Botanical Garden, Bronx Park, New York City.

Treasurer,

WILLIAM MANSFIELD, PHAR.D.

College of Pharmacy,
115 West 68th St., New York City.

MEETINGS

Meetings twice each month from October to May inclusive: the second Tuesday, at 8:00 P.M., at the American Museum of Natural History; the last Wednesday, at 3:30 P.M., in the Museum Building of the New York Botanical Garden.

PUBLICATIONS

All subscriptions and other business communications relating to the publications of the Club should be addressed to the Treasurer, William Mansfield, College of Pharmacy, 115 West 68th St., New York City.

Bulletin. Monthly, established 1870. Price, $3.00 a year; single numbers 30 cents. Of former volumes, only 24–34 can be supplied separately; certain numbers of other volumes are available, but the entire stock of some numbers has been reserved for the completion of sets. Manuscripts intended for publication in the BULLETIN should be addressed to Marshall A. Howe, Editor, New York Botanical Garden, Bronx Park, New York City.

Torreya. Monthly, established 1901. Price, $1.00 a year. Manuscripts intended for publication in TORREYA should be addressed to Jean Broadhurst, Editor, Teachers College, Columbia University, New York City.

Memoirs. Occasional, established 1889. (See last pages of cover.)

Preliminary Catalogue of Anthophyta and Pteridophyta within 100 miles of New York City, 1888. Price, $1.00.

Vol. 35 No 12

BULLETIN

OF THE

TORREY BOTANICAL CLUB

DECEMBER, 1908

Studies of West Indian plants — II

Nathaniel Lord Britton

7. HARRISIA, A NEW GENUS OF CACTACEAE

Night-flowering cacti with slender upright branched cylindric stems, the branches fluted, with from 8 to 11 rounded ribs, separated by shallow grooves and bearing areoles at frequent intervals, each areole with several acicular spines. Flowers borne singly, at areoles near the ends of the branches, funnelform, large, with a cylindric scaly but spineless tube as long as the limb or longer; buds globose, ovoid or obovoid, densely scaled, the scales bearing long or short woolly hairs; sepals pink or greenish, linear-lanceolate; petals white; stamens shorter than the petals, style somewhat longer than the stamens; fruit globose to ovoid-globose, green to yellow, spineless but with deciduous scales, the corolla withering-persistent; seeds very numerous, small.

The genus is named in honor of William Harris, Superintendent of Public Gardens and Plantations of Jamaica, distinguished for his contributions to the knowledge of the flora of that island. The descriptions are drawn up mainly from field observations and from living plants in the collections of the New York Botanical Garden.

Bud-scales densely covered with hairs 1–1.5 cm. long.
- Hairs bright white; areoles 2.5–3 cm. apart; spines 6–9, the longer 2.5–3 cm. long. — 1. *H. eriophorus.*
- Hairs tawny; areoles 2–2.5 cm. apart; spines 8–11, the longer 1 cm. long. — 2. *H. Fernowi.*

Bud-scales loosely covered with hairs 3–10 mm. long.
- Buds rounded-truncate. — 3. *H. portoricensis.*
- Buds pointed.
  - Plant dark green; hairs of the bud-scales straight. — 4. *H. gracilis.*
  - Plants light green; hairs of the bud scales curled.

[The Bulletin for November, 1908 (35 : 517–560. *pl. 36–40*) was issued 30 N 1908.]

Spines 3–6, the longer 1.5 mm. long; buds obovoid, very short-pointed. 5. *H. Nashii.*

Spines 9–15; buds ovoid to subglobose.

Areoles 1 cm. apart; spines 1 cm. long. 6. *H. undata.*

Areoles 2–3 cm. apart; longer spines 2–5 cm. long.

Buds ovoid, long-pointed; longer spines 2.5 cm. long. 7. *H. Brookii.*

Buds subglobose, short-pointed; longer spines 4–5 cm. 8. *H. Taylori.*

1. **Harrisia eriophora** (Pfeiff.)

Cereus cubensis Zucc.; Seitz, Allg. Gartenz. **2**: 244. 1834.

[Hyponym.]

Cereus eriophorus Pfeiff. Enum. 94. 1837.

Plant rather light green, the main stem 4 cm. in diameter or more, the branches nearly as thick, erect-ascending, 8-ribbed or 9-ribbed, the ribs prominent, the depressions between them rather deep. Areoles 3–4 cm. apart; spines 6–9, the longer ones 2.5–4 cm. long, light brown with nearly black tips; buds ovoid, sharp-pointed, their scales densely covered with bright white woolly hairs 1–1.5 cm. long; flower about 18 cm. long; scales of the tube lanceolate, acuminate, appressed, 1–1.5 cm. long, bearing long white hairs; sepals pale pink outside, the outer greenish; petals pure white, tipped with a hair-like cusp 5 mm. long; filaments white; anthers oblong, yellow; pistil cream-colored.

Description from N. Y. B. G. *no. 28933*, collected by C. F. Baker at Cajimar, Cuba, in 1907.

TYPE LOCALITY: Cuba.

DISTRIBUTION: Cuba.

ILLUSTRATION: Pfeiff. & Otto, Abb. u. Beschr. Cact. *pl. 22.*

2. **Harrisia Fernowi** sp. nov.

Plant 2.5–3 m. high; branches slender, about 2.5 cm. thick, light green, 9-ribbed, the ribs not prominent, the depressions between them shallow. Areoles about 2 cm. apart; spines 8–11, light brown with blackish tips, the longer ones 1 cm. long; bud subglobose-ovoid, its scales rather densely covered with tawny curled woolly hairs 1 cm. long; flower nearly 2 dm. long.

Cereus pellucidus Griseb. Cat. Pl. Cub. 116. 1866. Not *C. pellucidus* Otto. 1837.

Description mainly from N. Y. B. G. *no. 25766*, collected by Norman Taylor (*no. 254*), between Rio Grande and Rio Ubero, in

eastern Cuba in company with Prof. B. E. Fernow, in 1906; collected also by C. Wright, near Guantanamo.

3. **Harrisia portoricensis** sp. nov.

Plant slender, 2–3 m. high, little branched, the branches 3–4 cm. thick, 11-ribbed, the ribs rounded, the depressions between them shallow. Areoles 1.5–2 cm. apart; spines 13–17, grayish white to brown with dark tips, the longer ones 2.5–3 cm. long; bud obovoid, depressed-truncate, its scales with many curled white hairs 6 mm. long or less; flower about 1.5 dm. long; sepals pinkish green inside; scales of the corolla-tube lanceolate, appressed, 1.5 cm. long, loosely hairy, the hair completely deciduous in flakes; fruit ovoid, yellow, tubercled, acuminate at the apex, rounded at the base, 4 cm. long, 3 cm. in diameter.

Description from N. Y. B. G. *no. 24653*, collected by N. L. Britton and John F. Cowell, near Ponce, Porto Rico (*no. 1324*), in 1906.

4. **Harrisia gracilis** (Mill.)

Cereus gracilis Mill. Gard. Dict. ed. 8, no. 8. 1768.

Cereus repandus Haw. Syn. Pl. Succ. 183. 1812. Not *Cereus repandus* L.

? *Cereus subrepandus* Haw. Suppl. Pl. Succ. 78. 1819.

Plant much branched, often 7 m. high, dark green, its branches rather slender, somewhat divergent, 9–11-ribbed, the ribs rounded, the depression between them rather shallow. Areoles 1.5–2 cm. apart; spines 10–16, whitish with black tips, the longer 2–2.5 cm. long; bud oblong-ovoid, short-pointed, its scales with a few straight white hairs 8–12 mm. long; corolla 2 dm. long, the scales of its tube greenish brown, narrowly lanceolate, abruptly bent upward near the base, acuminate, about 2 cm. long, having a few hairs, the sepals pale brown, the petals white; fruit depressed globose, yellow, about 5 cm. long, 6–7 cm. thick, the base flat, the top bluntly pointed, strongly tubercled when young, the tubercles low-conic, about 4 mm. high, about 1.5 cm. from tip to tip, bearing a deciduous triangular-lanceolate scale 6–8 mm. long, becoming confluent, the fruit finally smooth or nearly so.

Description from N. Y. B. G. *no. 21902*, collected in Jamaica by Mr. John F. Cowell in 1904, and from *Britton 1255*, Great Pedro Bay, Jamaica. This plant has been observed by me in great quantities in the arid districts of the southern part of Jamaica, and is represented in our collections by living specimens from six localities. I designate this species as the type of the genus.

TYPE LOCALITY: British Islands of America.

DISTRIBUTION: Jamaica.

Harrisia gracilis has been illustrated as follows: Trew, Pl. Select. *pl. 14*; Bot. Reg. *pl. 336*, as *Cactus repandus*; DC. Mém. Mus. Paris **17**: *pl. 3*, as *Cereus repandus*.

5. **Harrisia Nashii** sp. nov.

Branches widely divergent, light green, 3–4 cm. thick, 9–11-ribbed, the ribs rounded. Areoles 2–2.5 cm. apart; spines only 3–6, gray, the longer ones 15 mm. long; bud narrowly obovoid, obtuse, very short-pointed, its scales with many curled white hairs 6 mm. long or less; corolla 1.6 dm. long; scales of the corolla-tube linear, acuminate, 1.5 cm. long, bearing a few hairs; fruit ellipsoid, 6–8 cm. long. 4–5 cm. thick, very strongly tubercled, the conic tubercles 6–8 mm. high.

Description from N. Y. B. G. *no. 24089*, collected between Gonaives and Plaisance in Haiti by G. V. Nash and Norman Taylor (*no. 1765*), in 1905.

ILLUSTRATION: ?Descour. Fl. Med. Ant. **1**: *pl. 66*, as *Cactus divaricatus*.

6. **Harrisia undata** (Pfeiff.)

Cereus undatus Pfeiff. Enum. Cact. 94. 1837.

Plant branched, about 2 m. high, the older branches light green, 10-ribbed, the ribs rounded, the depressions between them shallow; young branches dark green, only about 2 cm. thick. Areoles only 1 cm. apart; spines 12–15, gray, the longer ones only 1 cm. long; bud small, ovoid, short-pointed, its scales with few somewhat curled hairs 4–6 mm. long; flower (according to Pfeiffer and Otto) about 1.5 dm. long, the tube green, covered with acute loosely woolly scales, the petals white, denticulate.

Description from N. Y. B. G. *no. 19263*, obtained by N. L. Britton from the Havana Botanic Garden in 1903 (*no. 502*), and determined as *Cereus undatus* Pfeiff. by the description.

DISTRIBUTION: Cuba.

ILLUSTRATION: Pfeiff. & Otto, Abb. u. Beschr. Cact. *pl. 23*, which shows the areoles farther apart than they are in our living plants.

7. **Harrisia Brookii** sp. nov.

Plant 5 m. high, much branched, light green; branches 3–4 cm. thick, 10-ribbed, the ribs very prominent, with deep depressions between them. Areoles about 2 cm. apart; spines 9–12,

the longer ones 2–2.5 cm. long; bud ovoid, prominently long-pointed, its scales with few curled white hairs 7–10 mm. long; fruit yellowish, ellipsoid, about 8 cm. long, 5–6 cm. thick, rounded at both ends, the tubercles very low, with tips only 1.5 mm. high.

Description from N. Y. B. G. *no. 2614*, collected at Georgetown, Long Island, Bahamas, by N. L. Britton and C. F. Millspaugh, in 1907 (*no. 6337*). Named in honor of Hon. Herbert A. Brook, Registrar of the Bahamas, in recognition of his valuable aid in our exploration of these islands.

The plant of Florida, of which I do not yet know the buds or the flowers, more closely resembles this Bahamian species in its spines and areoles than it does any of the others here described. Our living plant, N. Y. B. G. *no. 19900*, was collected by Prof. P. H. Rolfs on islands east of Malabar and brought to the Garden by Dr. J. K. Small in 1903. As shown by an herbarium specimen, prepared by Dr. Small at that time (*no. 78*), the fruit of this species is nearly globular, about 5 cm. in diameter, and apparently smooth or nearly so. We also have an excellent photograph, taken by Mr. C. L. Pollard on Key Largo; and Curtiss' N. A. Plants *no. 963*, from a locality between the Indian River and the ocean, is this same species, which is described in Chapman's Southern Flora, at least in so far as the flower is concerned, under the name *Cereus monoclonos*, but it is not *C. monoclonos* of De Candolle.

8. **Harrisia Taylori** sp. nov.

Plant light green, branched above, 1.5–2 m. high, the branches divaricate-ascending, rather stout, 4 or 5 cm. thick, 9-ribbed, the ribs rounded, the depressions between them rather deep. Areoles 2–3 cm. apart; spines 9–12, the longer 3–5 cm. long, ascending; bud globose-ovoid, short-pointed, its scales with sparse curled grayish-white wool 3–6 mm. long.

Description from N. Y. B. G. *no. 25767*, collected by Norman Taylor on the sea-beach between Rio Grande and Rio Ubero, in eastern Cuba, in 1906 (*no. 253*).

9? CEREUS DIVARICATUS Lam. Encycl. 1: 540. 1783.

Cereus divergens Pfeiff. Enum. 95. 1837.

Pilocereus divaricatus Lemaire, Rev. Hort. 1862: 427. 1862.

TYPE LOCALITY: Santo Domingo.

DISTRIBUTION: Santo Domingo and Haiti.

ILLUSTRATION: Plumier, Pl. Amer. ed. Burmann, *pl. 193*.

Known only from Plumier's description and illustration; it may belong to the genus *Harrisia*, — although the long-exserted style seems to preclude it.

10? CEREUS ERECTUS Karw.; Pfeiff. Enum. 95. 1837.

TYPE LOCALITY: Mexico.

Referred in synonymy by Schumann to *Cereus repandus*, that is to say, presumably a *Harrisia*. Known only from the description.

Cereus repandus L., originally from Curaçao, is, from the description, presumably a *Cephalocereus*.

8. POTOMORPHE PELTATA (L.) MIQ.

POTOMORPHE PELTATA (L.) Miq. Comm. Phyt. 37. 1838.

Piper peltatum L. Sp. Pl. 30. 1753.

Piper umbellatum L. Sp. Pl. 30. 1753.

Potomorphe umbellata Miq. Comm. Phyt. 31. 1838.

Field observations in Jamaica demonstrate that the two supposed species of *Potomorphe* are not distinct. The difference of peltate and non-peltate leaves depended upon by Linnaeus and most subsequent authors who have had occasion to describe these plants, including M. Casimir de Candolle (in Urban, Symb. Ant. 3: 208–211), is worthless, because individual plants bear both kinds of leaves. I had long suspected this to be the case, and while discussing the matter with Mr. William Harris on the road from Bath to Cuna Cuna Gap last September, where specimens of both supposed species were abundant, he almost immediately detected a plant which bore peltate leaves at its upper nodes and non-peltate leaves at the lower ones, and we found a plenty of such specimens afterwards (*Britton 3513*). The relative number of spikes, which also has been supposed to differentiate the species, I had previously found to be quite inconstant, and the character of pubescence used in the descriptions by M. de Candolle is also inconstant, as evidenced by his proposing a hairy variety of *P. peltata* (*loc. cit.* 210, as *Piper peltatum hirtellum* C. DC.).

M. de Candolle includes the species in the genus *Piper*, and describes them as shrubs up to 4 meters high. As a matter of fact, the plant is not properly a shrub, its stems being soft, not

appreciably woody; his principal character to distinguish *Piper* from *Peperomia* is that *Piper* consists of shrubs and trees and *Peperomia* of herbs; *P. peltata* should then be excluded from *Piper*, and as it has distinct habital characteristics, differing widely from any true Pipers or Peperomias, I think it better regarded as a distinct genus under Miquel's name *Potomorphe*. Kunth, and also A. Dietrich, allowed it in *Peperomia*.

9. THE GENUS STEGNOSPERMA BENTH.

Stegnosperma was established by Bentham (Bot. Voy. Sulphur 17. *pl. 12.* 1844) with the single species *S. halimifolium* Benth. from Cape St. Lucas, Lower California. The next year, A. Richard (Ess. Fl. Cub. 632. 1845) proposed an additional species, *S. cubense* A. Rich. from Cuba. Moquin (in DC. Prodr. 13^2: 36. 1849) makes no mention of the Cuban plant, though recording it from Guatemala, but in Bentham and Hooker (Genera Plantarum 3: 86. 1880) the two supposed species are regarded as one, and its range extended to Santo Domingo.

The range is now extended to Jamaica, where the plant was found by us in the Healthshire Hills, an exceedingly dry region at about 100 meters elevation, south of Spanish Town (*Britton & Harris 10522; Britton 3062*); here it is a woody vine 8 m. long, climbing to the tops of low trees; its reddish fleshy fruits are 3-grooved, borne in short terminal racemes. The Mexican and Central American plant seems to me to be specifically identical with that of the West Indies, as maintained by Bentham and also by Heimerl in "Die natürlichen Pflanzenfamilien."

10. UNDESCRIBED SPECIES FROM JAMAICA

Dorstenia jamaicensis Britton, sp. nov.

Rootstock erect, about 2 cm. long, 5 mm. thick, simple or branched, scarred by leaf-bases. Leaves 5–13; petioles flat, densely short-pubescent, 2–11 cm. long, about 1.5 mm. wide, erect or ascending, mostly longer than the blades; blades ovate to ovate-orbicular, rather firm in texture, 3–4.5 cm. long, 1.5–3.5 cm. wide, peltate below the middle, repand-dentate or nearly entire, papillose-scabrous above, short-pubescent beneath, especially on the 7–9 veins, which are slightly elevated and rather prominent; scape pubescent, about 2 cm. long, much shorter than the peti-

oles; receptacle peltate, purplish, puberulent, 8–10 mm. broad, saucer-shaped, its margin with about 20 triangular-subulate teeth 0.5 mm. long; flowers dark purple.

On vertical limestone cliffs, Somerset, Parish of Manchester, Jamaica, Sept. 22, 1908 (*Britton 3737*, type; *Harris & Britton 10607*). An interesting addition to the West Indian peltate-leaved Dorstenias, three being known from Cuba and one from Santo Domingo.

Trichilia Harrisii sp. nov.

A tree about 7 m. high, the twigs and leaves glabrous. Leaves 2–3 dm. long; petiole 1.5–2.5 cm. long; leaflets 5–9, flat, thin, oblong-lanceolate to ovate-elliptic, faintly pinnately veined with about 15 veins on each side of the midrib, narrowed or rounded and somewhat oblique at the base, rather long-acuminate at the apex, the larger ones 10–16 cm. long, 4–7.5 cm. wide; petioles 5–8 mm. long; fruiting panicles 15 cm. long or less, its branches finely appressed-pubescent; fruiting pedicels stout, 2–3 mm. long; capsule globose to oval, 1–2.5 cm. long, blunt or pointed, rugose, densely velutinous, tardily dehiscent.

In woods near summit of Dolphin Head Mountain, Hanover, Jamaica, March 18, 1908 (*Britton 2263*, type; *2269; Harris 10282, 10286*).

11. ADDITIONS TO THE LIST OF JAMAICA SEDGES

In 1907 I contributed an enumeration of the sedges of Jamaica to the Bulletin of the Jamaica Department of Agriculture (5: Supplement 1). Further exploration of that island in the autumn of 1907 and in the spring and autumn of 1908 has disclosed the occurrence of some additional species and the habitat of others which were recorded by me from the statements of other botanists.

KYLLINGA INTERMEDIA R. Br. Prodr. 219. 1810.

Pasture, Cornwall near Lacovia (*Britton 1499*). Distribution: Cuba; Australia.

KYLLINGA PERUVIANA Lam. Encyl. 3: 366. 1789.

Not uncommon in swamps along the coasts.

CYPERUS HUMILIS Kunth, Enum. 2: 23. 1837.

East of Port Antonio (*Wight 54*); rocky thicket, Salem (*Britton 2542*); edge of water-hole, Lucea (*Britton 2906*). Distribution: Cuba; Martinique; Central America.

CYPERUS BROMOIDES Humb.; Link, Jahrb. 3: 85. 1820.

Marsh west of Black River (*Britton 1353*). Distribution: Cuba; Haiti; California to Mexico and Paraguay.

CYPERUS OXYLEPIS Nees; Steud. Syn. Pl. Cyp. 25. 1855.

Ditches near Salt Ponds, south of Spanish Town (*Britton 3032*). Previously collected in Jamaica only by Alexander. Distribution: northern South America.

CYPERUS ESCULENTUS L. Sp. Pl. 45. 1753.

Ditch near Flat Bridge, Rio Cobre (*Britton 3092*). West Indian distribution: Bermuda; Cuba; Martinique; Guadeloupe.

CYPERUS DIGITATUS Roxb. Hort. Bengal. 81. 1813.

Border of Black River, Lacovia (*Britton 1482*). Distribution: tropical and subtropical regions of the Old World and the New.

CYPERUS ANCEPS Liebm. Mex. Halvgr. 25. 1850.

In my paper in the Jamaica Bulletin, I followed Mr. C. B. Clarke, in Urban, Symb. Ant. 2: 44, in recording the continental North American *Cyperus tetragonus* Ell. from Jamaica, and in referring *C. anceps* to it as a synonym, but abundant material now convinces me that the species are distinct. This sedge is plentiful on grassy hillsides and banks in the parish of Manchester (*Britton 1024, 3161*); also at Woodstock near Newmarket, in Westmoreland (*Britton 1567*). Distribution: Cuba.

CYPERUS GRANULARIS (Desf.) Britton, Bull. Jam. Dept. Agric. 5: Suppl. 1, 9. 1907.

Dry soil, Longacre Point (*Britton 1383*). Distribution: Haiti to St. Croix.

ELEOCHARIS CAPILLACEA Kunth, Enum. 2: 137. 1837.

In mud, marsh west of Black River (*Britton 1354*). Distribution: southern United States; Cuba; South America.

FIMBRISTYLIS AUTUMNALIS (L.) R. & S. Syst. 2: 97. 1817.

Border of pond, Cornwall, Lacovia (*Britton 1493*). Distribution: United States; Cuba.

RYNCHOSPORA JUBATA Liebm. Vidensk. Selsk. Skr. V. 2: 254. 1851.

Marsh west of Black River (*Britton 1356*); border of Great Morass, Negril (*Britton 2116*). Distribution: Bahamas; Cuba; Mexico to Paraguay.

An analogy between the development of the plates of crinoids and the leaves of Sassafras

Edwin W. Humphreys

It is a fact, well known to paleontologists, that the calcareous plates in the arms of crinoids are arranged in a single row in certain species, as in the Pisocrinidae and other members of the order Larviformia, or in a double row, as in *Encrinus liliiformis* and others. The biserial forms are uniserial at the lower end and here the plates are quadrangular in shape. These latter grade into wedge-shaped plates, which are next followed by biserially arranged and more or less pentagonal-shaped ones.

It was pointed out not long ago, by Dr. A. W. Grabau,* that in a number of forms, in following on toward the tips, the same series of changes is repeated, but in reversed order, so that the uniserial quadrangular plates are again found at the upper ends. There is then, starting from the base and working upward, or from the tip and proceeding downward, a change in the plates from a uniserial to a biserial arrangement and from a quadrangular, more or less regular outline, to one that is irregularly pentagonal. In other words the plates of simplest form and arrangement are at the two extremities and the more complex ones are between them. Figures 1a and 1b are reproductions of two of Dr. Grabau's figures illustrating these features.

From the arm plates of crinoids to the leaves of *Sassafras* may seem like a far call, but it is an interesting fact that in the leaf arrangement in many of the branchlets of a season's growth, in suckers, and in seedlings of *Sassafras*, the arrangement of the plates in the biserial crinoid arm is at once suggested. Examination of a large number of specimens collected in Bronx Park has shown none but entire leaves at the bases of all of them, while above these are either or both the bilobed and trilobed ones. The order in which these latter two forms appear is not constant, however. Sometimes the bilobed ones are below the trilobed and vice

* Amer. Jour. Sci. **16**: 289–300. *f. 1–11.* 1903.

versa. Above these there are again entire leaves. It is not to be understood, however, that this arrangement holds good in all specimens, for while it seems to be a fact that all of them have entire leaves below, with lobed ones following, it is not invariably the

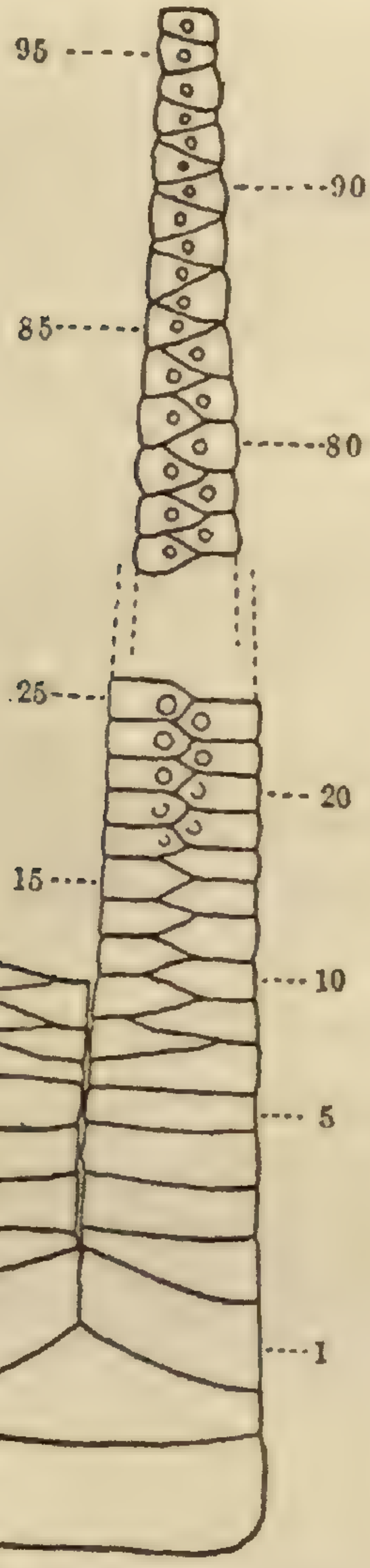


FIG. 1a. *Encrinus lilliformis*. Diagram of arms, showing arrangement and shape of plates. Reproduction of Grabau's fig. 1a.

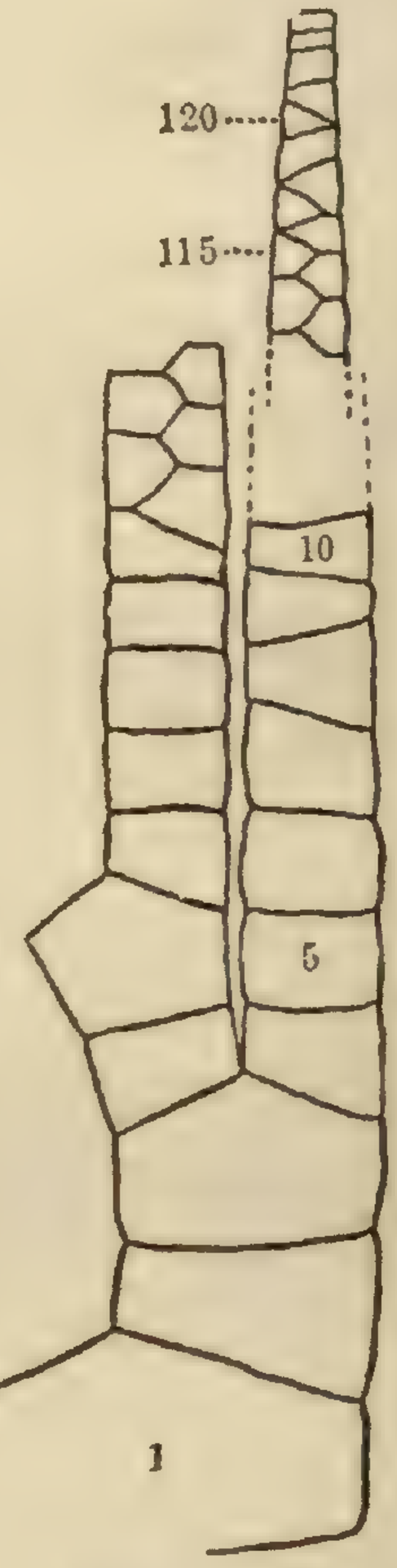


FIG. 1b. *Platycrinus hemisphericus*. Diagram of part of arm group, showing similar conditions. Reproduction of Grabau's fig. 7.

The numbers on the figures represent the serial numbering of the plates, counted from the basal one upward.

case that there are nothing but entire leaves above. A number of specimens were found in which there were no entire leaves at the top, and others on which the entire and lobed ones were mixed. Examples of two branchlets with the leaf forms and arrangement above described are shown in FIGURES 2a and 2b.

The opening bud in early spring forecasts the subsequent arrangement of the leaves on the stems. The outer ones are entire, while the inner ones are lobed. The upper zone of leaves cannot, however, be seen, as the buds are not yet sufficiently opened, but as the bud expands and the new branch grows the entire leaves remain at intervals along the lower part of the branch, while the lobed ones are carried higher up, and finally the second series of entire leaves unfolds at the top. As, therefore, in the crinoid arm, the simplest forms of structure are found at the base and tip, with the more complex ones between them.

It seems probable that this arrangement of the leaves in *Sassafras* has, like the arrangement of the plates in the biserial crinoid arm, some phylogenetic significance. In regard to the crinoids it is believed that the grouping of the plates epitomizes the life-history or development of the organisms to which they belong, and that this history, having its climax in the central part of the arm, may be read either upward from the base or downward from the tip. It is inferred, therefore, that the earliest crinoids of any genetic series had simple uniserial arms with quadrangular plates, and that gradually the plates became biserial in arrangement and more complex in form. There are also other facts which indicate that this is the correct interpretation.

In like manner the leaf arrangement described seems to indicate that it also summarizes the development of the *Sassafras* branch and its leaves, and that this story may be similarly read, either upward or downward, although the change from entire to lobed leaves is more abrupt and less gradual than is the transition from quadrangular to pentagonal plates in the crinoid arm. If this analogy holds true, it leads to the inference, therefore, that the ancestral type of *Sassafras* had entire leaves and that these are the primitive leaf forms, while the lobed ones are a later development.

Since writing the above my attention has been called to R. T. Jackson's observations on *Sassafras*, in his "Localized Stages in Development in Plants and Animals." * The inference above expressed, however, in regard to the ancestral type of *Sassafras* leaf,

* Mem. Boston Soc. Nat. Hist. 5: 89–153. *pl. 16–25.* 1899.

FIGS. 2a, 2b. Branchlets of *Sassafras Sassafras* (L.) Karst., showing arrangement of entire and lobed leaves. Collected in Bronx Park, New York, N. Y., October, 1908.

is different from his, which is that the lobed forms are the primitive or ancestral type, and is, I think, more in accord with the recapitulation theory. Indeed, Jackson recognizes the difficulties of his interpretation and that under it *Sassafras* becomes an exception to the usual condition. He says:* "The fact that seedlings start with entire leaves and later acquire lobed leaves like the earliest fossil representatives seems difficult to harmonize with the usual condition, where the first leaves are like the primitive or ancient types, and later leaves are different, being more specialized, as in *Liriodendron*, white ash, and *Platanus*." Now while it is true that what are generally recognized as the earliest ancestral forms of *Sassafras* leaves are lobed, and that apparently there are no entire fossil *Sassafras* leaves known, as remarked by E. W. Berry in his "Notes on Sassafras," † nevertheless, as the latter author well says, there are several fossil leaves with entire margins, which are referred to other genera, that might with equal propriety be referred to *Sassafras*, such for example as *Cinnamomum Heerii* Lesq.,‡ and anyone familiar with figures of fossil leaves may readily recall other species in this and other genera which compare very closely with certain of the entire leaf forms in the living *Sassafras*. It may also be pertinent to remark that the determination of genera in fossil botany, based upon leaves only, has not attained to such precision that all leaves can with certainty be referred to their correct genera. Further than this, it may be recalled that even the correctness of the reference of many fossil lobed leaves to the genus *Sassafras* has been questioned or criticized by competent authorities. Thus the fact that lobed leaves were actually the earliest ancestral forms is by no means definitely established. The entire forms may yet be found, either as new discoveries or as species incorrectly referred to other genera. Jackson's interpretation, therefore, which places the lobed leaves as the earliest forms, may not be in accordance with the actual facts, but opposed to them, and since it necessitates an apparent exception to the usual condition, requiring a devious explanation, the better course would seem to be to regard the

* *Loc. cit.* 108.

† Bot. Gaz. 34: 426–450. *pl.* 18 + *f.* 1–4. 1902.

‡ *Loc. cit.* 433.

entire leaf as the earliest ancestral form, the fossil representatives of which are at present either undiscovered or perhaps incorrectly referred to certain other lauraceous genera.

Finally, it appears logical to infer in regard to reversionary leaf forms, which are really not reversions but forms which have not developed beyond the ancestral condition, that if they do occur they should appear when the growth of the tree is least vigorous, and that the leaves of full development should appear when the tree is in its period of maximum growth. Growth is least vigorous in early spring, when the tree is awakening from its dormant condition, and in autumn when it is preparing for it. The leaves which appear at these periods are the simplest in form. Summer is the time of maximum vigor of growth and the leaves which appear at that period are the most highly specialized or differentiated. Further than this, in any given growing season the bud for the next season is already being formed. The outer leaves of the bud, which become the lower leaves of the next season's branch, are the first formed and are therefore formed during the early part of the growing season, while the innermost ones, which subsequently become the uppermost ones of the future branch, are formed late in the growing season. These are the simplest in form. The intermediate zone of bud leaves, which are destined to occupy the median part of the branch, are formed during the height of the growing season, when conditions are most favorable for full development. These are the lobed ones.

From every point of view in which actual facts are in our possession it therefore seems reasonable to regard the entire leaves as the type of the ancestral form, and the arrangement of the several leaf forms on the branch as representing the development of the organism as a whole from infancy to maturity and back again to second childhood or old age.

I desire to acknowledge the kindly assistance of Professor A. W. Grabau, of Columbia University, and of Dr. Arthur Hollick, of the New York Botanical Garden, in the preparation of this paper.

North Dakota slime-moulds

Fred J. Seaver

During the fall of 1907 and spring of 1908, in connection with the study of the fungus flora of North Dakota, a number of species of slime-moulds were collected, and since there is no available literature on this particular phase of the cryptogamic flora of the state, it is thought advisable to publish the list at this time. The work above mentioned was carried on in connection with the North Dakota Agricultural College and specimens of the species reported on here are preserved in the herbarium of that institution, to which I am indebted for the privilege of carrying on the work.

With few exceptions, such as that of the disease known as the club-rot of cabbage, the slime-moulds are not known to be of any economic importance, and since they are usually small and grow in out of the way places little attention is given to them. But notwithstanding their failure to appeal to those interested in the commercial phases of the botanical science only, their strange life-history, delicate structure, and uncertain relationship with other groups of plants and animals never fail to arouse the interest of the student in the class-room and it was for this reason that most of the species reported here were first collected.

In preparing this list acknowledgments are due to Professor T. H. Macbride, of Iowa, for identification or confirmation of the identification of the species named below.

PHYSARACEAE

Cienkowskia reticulata (Albert. & Schwein.) Rost.

This is the only species of the genus and according to Professor Macbride, in the North American Slime-moulds, is very rare. The species was at first mistaken for an immature plasmodium, which it very closely resembles.

Diderma crustaceum Peck.

Common and rather attractive. The species has been collected several times in North Dakota, usually on the stems of herbaceous

plants and often some distance above ground, an adaptation for spore distribution.

DIDYMIUM SQUAMULOSUM (Albert. & Schwein.) Fries.

On leaves and decaying materials of various kinds. A common species.

FULIGO OVATA (Schaeff.) Macbr.

This is a common species and one which often attains considerable size. One specimen collected on a rotten log in North Dakota was from six to eight inches in diameter and smaller specimens were found to be very common.

PHYSARUM CONTEXTUM Pers.

Several collections were made on decaying materials of various kinds in woods near Fargo.

TILMADOCHE VIRIDIS (Bull.) Sacc.

Plants collected on rotten wood. The species is not uncommon and has a wide distribution.

STEMONITACEAE

STEMONITIS MAXIMA Schwein.

Numerous specimens were collected on bark and wood of *Tilia americana*, for which substratum it shows a decided preference. Widely distributed.

STEMONITIS SMITHII Macbr.

The specimens, collected in similar localities to the preceding, were mostly larger and easily distinguished from that species by the color of the spore mass, which is ferruginous instead of purplish black. Rather common.

CRIBRARIACEAE

DICTYDIAETHALIUM PLUMBEUM (Schum.) Rost.

Several collections on decaying wood. The plants are depressed and spread out, becoming 1–2 cm. in diameter and recognized by these characters and the ochraceous color. The one species known to North America has a wide distribution.

DICTYDIUM CANCELLATUM (Batsch) Macbr.

One of the most variable species of the group, the plants being either long- or short-stemmed and very variable in color.

TUBIFERA FERRUGINOSA (Batsch) Macbr.

Collected on rotten wood and distinct in the tubiferous sporangia, which persist long after the shedding of the spores. The sporangia occur in dense masses.

LYCOGALACEAE

LYCOGALA EPIDENDRUM (Bux.) Fries.

The young phases of this plant are often met with in woods, and the bright red color of the plasmodium of the forming sporangia make them rather conspicuous objects. At maturity, however, the sporangia lose their bright color and become more nearly the color of the substratum on which they occur. Said to be the most common slime-mould in the world.

TRICHIACEAE

ARCYRIA INCARNATA Pers.

The plants of this species are often found closely crowded on rotten stumps, sometimes covering an area of several inches. At maturity the delicate threads of the capillitium push out so that the entire group of plants resembles rich flesh-colored velvet.

ARCYRIA DENUDATA (L.) Sheld.

Plants resembling those of the preceding species but distinguished by the dull reddish brown color. The species was found to be common but did not occur in such abundance as the preceding.

HEMITRICHIA CLAVATA (Pers.) Rost.

Common on rotten wood and distinguished by the stipitate, cup-shaped remains of the sporangia containing the golden yellow capillitium. The twisted rope-like appearance, which is one of the characteristics of the genus, is revealed only by microscopic examination.

HEMITRICHIA VESPARIA (Batsch) Macbr.

At once recognized in the field as distinct from the preceding by the dark reddish purple color of the sporangia. Several collections made on rotten wood. The species is common.

TRICHIA PERSIMILIS Karst.

Rather common and widely distributed in North America.

OLIGONEMA FLAVIDUM (Peck) Massee.

The sporangia of this species grow closely crowded together in little masses and the species is quite distinct in this character and the bright yellow color of the sporangia.

NEW YORK BOTANICAL GARDEN.

Two imperfectly known species of Crataegus

FRANCIS RAMALEY AND G. S. DODDS

So much misunderstanding exists in regard to certain *Crataegi* of Colorado that further notes intended to clear up the difficulties may not be amiss. Dr. Rydberg, in his excellent Flora* did not extricate the species from the perplexity of much description. Two of the best-marked species, *C. occidentalis* and *C. coloradensis*, although recognized by him as distinct, cannot be separated by the use of his key.

These two species were studied by Professor Cockerell† and clearly separated. Unfortunately the names given by Professor Cockerell are, by further study, found to be either incorrect or else not the earliest. The present writers, after considerable field study, are in a position to add certain characters not mentioned by him and thus help to straighten out difficulties. Also, through the courtesy of Dr. N. L. Britton, who has kindly reëxamined his type of *Crataegus occidentalis*, some characters may now be stated in regard to the species which were not printed in the original description (length of petiole, pubescence of twigs, etc.).

The synonymy of the two species under consideration is as follows:

CRATAEGUS OCCIDENTALIS Britton, Bull. N. Y. Bot. Garden **1**: 448. Mr 1898.

C. Colorado Ashe, N. C. Agric. Exp. Sta. Bull. 175: 110–113. Au 1900.

C. macracantha occidentalis Eggleston, Rhodora **10**: 82. 1908. In part.

CRATAEGUS COLORADENSIS A. Nelson, Proc. Biol. Soc. Wash. **17**: 175. D 1904.

C. occidentalis Cockerell, Univ. of Colo. Studies **5**: 42. 1907. Not *C. occidentalis* Britt.

---

* Rydberg, P. A. Flora of Colorado, Colo. Agric. Coll. Exp. Sta. Bull. 100: 192. 1906.

† Cockerell, T. D. A. Univ. of Colo. Studies **5**: 41–45. 1907.

C. macracantha occidentalis Eggleston, Rhodora 10: 82. 1908. In part.

COMPARISON OF THE TWO SPECIES

C. occidentalis	*C. coloradensis*
FORM AND SIZE	FORM AND SIZE
Small, much-branched tree with crooked trunk and limbs, 2–6 m. high, sometimes shrub-like and dwarfed.	Spreading round-topped tree, 2–6 m. high, usually symmetrical, not crooked or much branched.
BRANCHES AND TWIGS	BRANCHES AND TWIGS
Branches gray; twigs blackish, those of the season loosely villous. Bud-scales large, persistent to flowering time, the midrib pink-purplish.	Branches gray; twigs brownish, those of the season shining chestnut-brown, glabrous. Bud-scales small, early deciduous.
LEAF-BLADES	LEAF-BLADES
Broadly obovate or oval, coarsely toothed, with a tendency to become 4 or 5-lobed.	The same.
Very rough, dark green but not bluish green nor bronze-green.	Moderately rough, dark bluish green or bronze-green.
Scatteringly pubescent above, pubescent on the veins below.	The same.
PETIOLES	PETIOLES
About $\frac{1}{6}$ or $\frac{1}{5}$ the length of the blade, pubescent.	About $\frac{1}{4}$ the length of the blade, pubescent.
INFLORESCENCE	INFLORESCENCE
Broad or flat-topped corymb; pedicels villous.	Broad or flat-topped corymb; pedicels somewhat pubescent.
FLOWERS	FLOWERS
About 16 mm. broad.	The same.
Stamens 10 or less.	The same.
Anthers white or cream-colored.	Anthers pink or rose-colored.
Calyx-tube conical, the lobes villous, with slender gland-tipped teeth.	Calyx-tubes very short conical, the lobes sometimes villous with slender gland-tipped teeth.
FRUIT	FRUIT
Bright red, soft-pulpy.	The same.
Broader than long, 10–12 mm. broad, 9–11 mm. long.	Spherical, 10 mm. in diameter.
Indented at base where attached to pedicel; the latter not club-shaped.	Not indented where attached to pedicel; the latter club-shaped.

From the above comparison it is evident that the two species are easily distinguished. The present writers cannot agree with Mr. Eggleston, who, as cited above, combines them and places this

much-lumped group as a variety under an eastern species. The Rocky Mountain species of *Crataegus* are restricted in distribution to canyon mouths and gulches of the lower foothills. They do not occur on the plains. Hence it seems best to consider them as specifically distinct from eastern species. The discontinuous distribution in itself would be almost sufficient ground for such separation, but the characters of our Colorado species are so good that they certainly deserve separate treatment.

C. occidentalis and *C. coloradensis* may be distinguished with ease in the field or the herbarium, whether flowering or fruiting specimens are examined. Indeed, with neither flowers nor fruits it is an easy matter to separate them from each other, although not so easy to distinguish *C. occidentalis* from some other closely related forms.

UNIVERSITY OF COLORADO,
BOULDER, COLO.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1904–1907)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

This Index is reprinted monthly on cards, and furnished in this form to subscribers, at the rate of one cent for each card. Selections of cards are not permitted; each subscriber must take all cards published during the term of his subscription. Correspondence relating to the card-issue should be addressed to the Treasurer of the Torrey Botanical Club.

Bessey, C. E. A synopsis of the plant phyla. Univ. Studies [Univ. of Nebraska] **7**: 275–373 (1–99). O 1907.

Britton, N. L. Lucien Marcus Underwood. Columbia Univ. Quart. **10**: 67–69. *portrait.* D 1907.

Brodie, W. A new station for a northern fern. Ontario Nat. Sci. Bull. **2**: 45. 18 My 1906.

Bryhn, N. Bryophyta in itinere polari norvagorum secundo collecta. 1–260. *pl. 1, 2.* Kristiania, 1907.

Report of the second Norwegian expedition in the "Fram." 1898–1902. No. 11.

Burlingham, G. S. A study of the influence of magnesium sulphate on the growth of seedlings. Jour. Am. Chem. Soc. **29**: 1095–1112. Jl 1907.

Carter, H. A. An addition to the list of Wellington County *Orchidaceae.* Ontario Nat. Sci. Bull. **2**: 46. 18 My 1906.

Christman, A. H. Observations on the wintering of grain rusts. Trans. Wisconsin Acad. **15**: 98–107. 1905.

Colgate, E. J. Notes on the flora of northern Wellington County. Ontario Nat. Sci. Bull. **2**: 45, 46. 18 My 1906.

Copeland, E. B. A new *Polypodium* and two varieties. Leaflets Philippine Bot. **1**: 78, 79. 26 Jl 1906.

Coulter, J. M. A text-book of botany. i–x + 1–365. *f.* 1–320. New York, 1906.

Coulter, S. Michillinda (Michigan) sand dunes and their flora. Proc. Indiana Acad. Sci. **1906**: 122–128. 1907. [Illust.]

Coulter, S. Notes upon the rate of tree growth in glacial soils in northern Indiana. Proc. Indiana Acad. Sci. **1906**: 114–121. 1907.

Deam, C. C. Additions to Indiana flora — no. 3. Proc. Indiana Acad. Sci. **1906**: 137, 138. 1907.

Denniston, H. R. The Russulas of Madison and vicinity. Trans. Wisconsin Acad. **15**: 71–88. 1904.

Domin, K. *Umbelliferae* novae extraeuropaeae — I. Repert. Nov. Spec. **4**: 298–300. 20 O 1907.

Includes *Bowlesia pilosa longipes* Domin var. nov.

Domin, K. Zwei neue *Azorella-Arten* aus Südamerika. Repert. Nov. Spec. **4**: 296–298. 20 O 1907.

A. ecuadorensis and *A. prismatoclada*.

Dusén, P. Neue und seltene Gefässpflanzen aus Ost- und Südpatagonien. Arkiv Bot. 7^2: 1–62. *pl. 9*. 4 S 1907.

Includes 20 new species and varieties.

Elmer, A. D. E. A fascicle of Benguet figs. Leaflets Philippine Bot. **1**: 42–62. 10 Ap 1906.

Elmer, A. D. E. A fascicle of East Leyte figs. Leaflets Philippine Bot. **1**: 187–205. 10 D 1906.

Elmer, A. D. E. Additional new species of *Rubiaceae*. Leaflets Philippine Bot **1**: 63–73. 12 Ap 1906.

Elmer, A. D. E. Manual of the Philippine *Compositae*. Leaflets Philippine Bot. **1**: 83–186. 16 Au 1906.

Elmer, A. D. E. New *Pandanaceae* from Mt. Banahao. Leaflets Philippine Bot. **1**: 78 [bis] –82. 1 Au 1906.

Elmer, A. D. E. Pandans of East Leyte. Leaflets Philippine Bot. **1**: 74–77. 15 Ap 1906.

Elmer, A. D. E. Philippine *Rubiaceae*. Leaflets Philippine Bot. **1**: 1–41. 8 Ap 1906.

Foslie, M. Algologiske notiser — IV. Kgl. Norske Vid. Selsk. Skr. 1907^6: 1–30. 1907.

Includes new species from California and the West Indies.

[Gibson, H. H.] American forest trees — [1]. Poplar or whitewood, *Liriodendron Tulipifera* Linn. Hardwood Record 19^6: 14, 15. 10 Ja 1905. [Illust.]

[Gibson, H. H.] American forest trees — 2. White oak, *Quercus alba* Linn. Hardwood Record 19^7: 13, 14. 25 Ja 1905. [Illust.]

[**Gibson, H. H.**] American forest trees — 3. Hard maple, *Acer Saccharum* Marsh. Hardwood Record **19**[8]: 12, 13. 10 F 1905. [Illust.]

[**Gibson, H. H.**] American forest trees — 4. Sycamore, *Platanus occidentalis* Linn. Hardwood Record **19**[9]: 12, 13. 25 F 1905. [Illust.]

[**Gibson, H. H.**] American forest trees — 5. American beech, *Fagus americana*. Hardwood Record **19**[10]: 14, 15. 10 Mr 1905. [Illust.]

[**Gibson, H. H.**] American forest trees — 6. Black birch, *Betula lenta* Linn. Hardwood Record **19**[11]: 12, 13. 25 Mr 1905. [Illust.]

[**Gibson, H. H.**] American forest trees — 7. Black ash, *Fraxinus nigra* Marsh. Hardwood Record **19**[12]: 12, 13. 10 Ap 1905. [Illust.]

[**Gibson, H. H.**] American forest trees — 8. Black walnut, *Juglans nigra* Linn. Hardwood Record **20**[1]: 14–16. 25 Ap 1905. [Illust.]

[**Gibson, H. H.**] American forest trees — 9. Basswood, *Tilia americana* Linn. Hardwood Record **20**[2]: 12, 13. 10 My 1905. [Illust.]

[**Gibson, H. H.**] American forest trees — 10. Cypress, *Taxodium distichum* (Linn.) Rich. Hardwood Record **20**[3]: 16, 18. 25 My 1905. [Illust.]

[**Gibson, H. H.**] American forest trees — 11. Chestnut, *Castanea dentata* (Marsh.) Borkh. Hardwood Record **20**[4]: 10, 11. 10 Je 1905. [Illust.]

[**Gibson, H. H.**] American forest trees — 12. White Ash, *Fraxinus americana* Linn. Hardwood Record **20**[5]: 12, 14. 25 Je 1905. [Illust.]

[**Gibson, H. H.**] American forest trees — 13. Shagbark hickory, *Hicoria ovata* (Mill.) Britton. Hardwood Record **20**[6]: 12, 13. 10 Jl 1905. [Illust.]

[**Gibson, H. H.**] American forest trees — 14. Red oak, *Quercus rubra* Linn. Hardwood Record **20**[7]: 12, 13. 25 Jl 1905. [Illust.]

[**Gibson, H. H.**] American forest trees — 15. Silverbell tree, *Mohrodendron carolinum* (Linn.) Britton; *Halesia tetraptera* Ellis. Hardwood Record **20**[8]: 10, 11. 10 Au 1905. [Illust.]

[**Gibson, H. H.**] American forest trees — 16. Black cherry, *Prunus serotina* Ehrh. Hardwood Record **20**[9]: 12, 13. 25 Au 1905. [Illust.]

[Gibson, H. H.] American forest trees — 17. American holly, *Ilex opaca* Ait. Hardwood Record **20**[10]: 10, 11. 10 S 1905. [Illust.]

[Gibson, H. H.] American forest trees — [18]. Red gum, *Liquidambar Styraciflua* Linn. Hardwood Record **20**[11]: 12–15. 25 S 1905. [Illust.]

[Gibson, H. H.] American forest trees — 19. Cottonwood, *Populus deltoides* Marsh., *Populus monilifera* Ait. Hardwood Record **20**[12]: 10, 11. 10 O 1905. [Illust.]

[Gibson, H. H.] American forest trees — 20. Sassafras, *Sassafras Sassafras* (Linn.) Karst.; *Sassafras officinale* Nees and Eberm. Hardwood Record **21**[1]: 12, 13. 25 O 1905. [Illust.]

[Gibson, H. H.] American forest trees — 21. Red maple, *Acer rubrum* Linn. Hardwood Record **21**[2]: 10, 11. 10 N 1905. [Illust.]

[Gibson, H. H.] American forest trees — 22. Ironwood, *Ostrya virginica* (or *virginiana*) Willd. Hardwood Record **21**[3]: 12, 13. 25 N 1905. [Illust.]

[Gibson, H. H.] American forest trees — 23. Buckeye, *Aesculus octandra* Marsh., *Aesculus flava* Ait. Hardwood Record **21**[4]: 10, 11. 10 D 1905. [Illust.]

[Gibson, H. H.] American forest trees — 24. Black gum, *Nyssa sylvatica* Marsh. Hardwood Record **21**[5]: 12, 13. 25 D 1905. [Illust.]

[Gibson, H. H.] American forest trees — 25. Live Oak, *Quercus virginiana* Mill., *Quercus virens* Ait. Hardwood Record **21**[6]: 10, 11. 10 Ja 1906. [Illust.]

[Gibson, H. H.] American forest trees — 26. White pine, *Pinus Strobus* Linn. Hardwood Record **21**[7]: 14–16. 25 Ja 1906. [Illust.]

[Gibson, H. H.] American forest trees — 27. Hemlock, *Tsuga canadensis* (Linn.) Carr. Hardwood Record **21**[8]: 10, 11. 10 F 1906. [Illust.]

[Gibson, H. H.] American forest trees — 28. Red cedar, *Juniperus virginiana* Linn. Hardwood Record **21**[9]: 12–14. 25 F 1906. [Illust.]

[Gibson, H. H.] American forest trees — 29. Loblolly or North Carolina pine, *Pinus Taeda* Linn. Hardwood Record **21**[10]: 14, 15. 10 Mr 1906. [Illust.]

[Gibson, H. H.] American forest trees — 30. Red spruce, *Picea rubens* Sargent. Hardwood Record **21**[11]: 14, 15. 25 Mr 1906. [Illust.]

[Gibson, H. H.] American forest trees — 31. Longleaf yellow pine, *Pinus palustris* Mill. Hardwood Record **21**[12]: 14, 15. 10 Ap 1906. [Illust.]

[Gibson, H. H.] American forest trees — 32. Bull pine, Arizona white pine, California pine, *Pinus ponderosa* Laws. Hardwood Record **22**[1]: 14, 15. 25 Ap 1906. [Illust.]

[Gibson, H. H.] American forest trees — 33. Hackberry, *Celtis occidentalis* Linn. Hardwood Record **22**[2]: 14, 15. 10 My 1906. [Illust.]

[Gibson, H. H.] American forest trees — 34. Water elm, *Planera aquatica* Gmel. Hardwood Record **22**[3]: 14, 15. 25 My 1906. [Illust.]

[Gibson, H. H.] American forest trees — 35. Black or yellow-bark oak, *Quercus velutina* Lam., *Quercus tinctoria* Bart. Hardwood Record **22**[4]: 14, 15. 10 Je 1906. [Illust.]

[Gibson, H. H.] American forest trees — 36. Norway or red pine, *Pinus resinosa* Ait. Hardwood Record **22**[10]: 16, 17. 10 S 1906. [Illust.]

[Gibson, H. H.] American forest trees — 37. Mahogany, *Swietenia Mahogani, Khaya senegalensis, Sayenida febrifuga.* Hardwood Record **22**[11]: 15, 16. 25 S 1906. [Illust.]

[Gibson, H. H.] American forest trees — 38. Chestnut oak, *Quercus Primus* Linn. Hardwood Record **22**[12]: 16, 17. 10 O 1906. [Illust.]

[Gibson, H. H.] American forest trees — 39. Cucumber tree, *Magnolia acuminata* Linn. Hardwood Record **23**[1]: 16, 17. 25 O 1906. [Illust.]

[Gibson, H. H.] American forest trees — 40. Black locust, *Robinia Pseudacacia* L. Hardwood Record **23**[2]: 16, 17. 10 N 1906. [Illust.]

[Gibson, H. H.] American forest trees — 41. American or gray elm, *Ulmus americana* Linn. Hardwood Record **23**[3]: 16, 17. 25 N 1906. [Illust.]

[Gibson, H. H.] American forest trees — 42. Overcup oak, *Quercus lyrata* Walt. Hardwood Record **23**[5]: 16, 17. 10 D 1906. [Illust.]

[Gibson, H. H.] American forest trees — 43. Red or river birch, *Betula nigra* Linn. Hardwood Record **23**[5]: 16, 17. 25 D 1906. [Illust.]

Glaziou, A. F. M. Plantae Brasiliae centralis a Glaziou lectae. Mém. Soc. Bot. France **3**: 113–200. Jl 1906.

Graenicher, S. The relations of the andrenine bees to the entomophilous flora of Milwaukee County. Trans. Wisconsin Acad. **15**: 89–97. 1905.

Harshberger, J. W. A grass-killing slime-mould. Proc. Am. Phil. Soc. **45**: 271–273. 1906.

Herriot, W. The *Cyperaceae* of the vicinity of Galt, Ont. Ontario Nat. Sci. Bull. **2**: 35–38. 18 My 1906.

Holm, T. *Eragrostis Purshii.* Ontario Nat. Sci. Bull. **2**: 46, 47. 18 My 1906.

Holm, T. On the etymology of plant names. Ontario Nat. Sci. Bull. **2**: 25–30. 18 My 1906.

Howe, R. H. & M. A. Common and conspicuous lichens of New England 3: 41–56. 4: 57–72. 1906. [Illust.]

Kern, F. D. Notes on the occurrence of *Sclerotinia fructigena.* Proc. Indiana Acad. Sci. **1906**: 134–136. 1907.

Kern, F. D. Parasitic plant diseases reported for Indiana. Proc. Indiana Acad. Sci. **1906**: 129–133. 1907. [Illust.]

Klugh, A. B. An introduced *Luzula.* Ontario Nat. Sci. Bull. **2**: 45. 18 My 1906.

Klugh, A. B. Another station for *Artemisia caudata.* Ontario Nat. Sci. Bull. **2**: 47. 18 My 1906.

Klugh, A. B. *Eclipta alba* in Canada. Ontario Nat. Sci. Bull. **2**: 46. 18 My 1906.

Klugh, A. B. *Helianthus strumosus mollis* in Ontario. Ontario Nat. Sci. Bull. **2**: 47. 18 My 1906.

Klugh, A. B. Notes on the *Cyperaceae* of Ontario. Ontario Nat. Sci. Bull. **2**: 23, 24. 18 My 1906.

Klugh, A. B. A *Panicum* new to Canada. Ontario Nat. Sci. Bull. **2**: 46. 18 My 1906.

Klugh, A. B. The *Cyperaceae* of Wellington County, Ontario. Ontario Nat. Sci. Bull. **2**: 38–42. 18 My 1906.

Klugh, A. B. The flora of a sandy marsh. Ontario Nat. Sci. Bull. **2**: 33–35. 18 My 1906.

Kränzlin, F. Eine neue *Calceolaria* aus Peru. Repert. Nov. Spec. **4**: 353. 31 D 1907.
C. Moyobambae.

Léveillé, H. Decades plantarum novarum — I. Repert. Nov. Spec. **4**: 225–227. 20 Au 1907.
Includes *Lopezia Glazioui* sp. nov., native in Brazil.

Lunell, J. *Sagittaria arifolia* Nutt. in North Dakota. Bull. Leeds Herb. 1 : [1–4]. 3 S 1907.

Macdougal, D. T., Vail, A. M., & Shull, G. H. Mutations, variations and relationships of the oenotheras. Carnegie Inst. Pub. no. 81. 1–92. *pl. 1–22.* + *f. 1–73.* Washington, 1907.

Moore, T. J. Notes on *Stachys germanica.* Ontario Nat. Sci. Bull. 2 : 47. 18 My 1906.

Nichols, S. P. The nature and origin of the binucleated cells in some *Basidiomycetes.* Trans. Wisconsin Acad. 15 : 30–70. *pl. 4–6.* 1905.

Olive, E. W. Notes on the occurrence of *Oscillatoria prolifica* (Greville) Gomont in the ice of Pine Lake, Waukesha County, Wisconsin. Trans. Wisconsin Acad. 15 : 124–134. 1905.

Pammel, L. H. A comparative study of the vegetation of swamp, clay, and sandstone areas in western Wisconsin, southeastern Minnesota, northeastern, central, and southeastern Iowa. Proc. Davenport Acad. Sci. 10 : 32–126. *f. 1–42.* 29 Je 1905.

Pfeiffer, W. M. Differentiation of sporocarps in *Azolla.* Bot. Gaz. 44 : 445–454. *pl. 31, 32.* D 1907.

Reed, G. M. Infection experiments with *Erysiphe Graminis* DC. Trans. Wisconsin Acad. 15 : 135–162. 1905.

Rehm, H., & Rick, J. Novitates brazilienses. Brotéria 5 : 223–228. 1906.

Includes 12 new species of *Basidiomycetes* and *Ascomycetes.*

Rick, J. Pilze aus Rio Grande do Sul (Brazilien). Brotéria 5 : 5–53. 1906.

Includes 44 new species.

Rosenstock, E. *Filices* novae — I. Repert. Nov. Spec. 4 : 2–6. 1 My 1907 ; — II. 4 : 292–296. 20 O 1907.

Includes new Brazilian species in *Lindsaya*, *Dryopteris* (2) and *Elaphoglossum* (3).

Spegazzini, C. Mycetes argentinenses — IV. Ann. Mus. Nac. Buenos Aires II. 9 : 25–33. 20 D 1906.

Includes one new species each in *Cypellomyces*, gen. nov., *Podaxon*, *Scleroderma*, *Arachnion*, and *Dictyophora.*

Thompstone, E. Notes on *Asarum canadense.* Ontario Nat. Sci. Bull. 2 : 31, 32. 18 My 1906.

Urban, I. *Turneraceae* novae Uleanae. Repert. Nov. Spec. 4 : 129–137. 1 Jl 1907.

Includes new Brazilian species in *Piriqueta* (3), and *Turnera* (5).

Vries, H. de. On twin hybrids. Bot. Gaz. **44**: 401–407. D 1907.

White, D. A remarkable fossil tree trunk from the middle Devonic of N. Y. N. Y. State Mus. Geol. Paper 107: 327–360. *pl. I–II.* 1907.

White, D. Report on fossil plants from the coal measures of Arkansas. U. S. Geol. Surv. Bull. **326**: 24–31. 1907.

Wildeman, É. de. *Ouratea cuspidata* Engler. Ic. Sel. Hort. Thenensis **6**: 65–67. *pl. 218.* S 1907.

Wildeman, É. de. *Heckeria peltata* Kunth. Ic. Sel. Hort. Thenensis **6**: 51–53. *pl. 214.* Je 1907.

Wildeman, É. de. *Polygonatum commutatum* Dietr. Ic. Sel. Hort. Thenensis **6**: 55–57. *pl. 215.* Je 1907.

INDEX TO VOLUME 35

New names, and the final members of new combinations, are in **bold face type.**

Acalypha gracilens, 352; virginica, 352
Acarospora **Carnegiei,** 297
Achillea, 358; Millefolium, 352
Acnida cannabina, 544; tamariscina, 544; tamariscina tuberculata, 544, tuberculata, 544
Acrolejeunea, 161, 162, 164, 165; polycarpa, 162
Acrostichum, 27
Actinopteris, 27
Additional Philippine Polyporaceae, 391
Adiantum, 27, 28; diaphanum, 272; setulosum, 272
Adopogon Dandelion, 548
Aecidium aurantiacum, 506; Botryapites, 506; germinale, 506
Agastache, 551; nepetoides, 551; scrophulariaefolia, 551
Agathis, 249–254, 256
Agoseris, 548
Agrimonia, 352, 358; Eupatoria, 552; mollis, 552
Agropyron, 533; littoreum, 200; repens, 200, 476; repens littoreum, 200; repens pilosum, 476
Agrostis alba, 191; alba aristulata, 473; alba vulgaris, 191; **antecedens,** 473–475; depressa, 192; elata, 192, 193; hyemalis, 192, 353, 474, 475; intermedia, 193; maritima, 191; perennans, 193
Aira caryophyllea, 193
Alabastra philippinensia, 63
Albertia, 250
Albugo Bliti, 362, 544; candida, 545, 546; Cladothricis, 362; **Froelichiae,** 362; Ipomoeae-panduranae, 549; Lepigoni, 543; occidentalis, 361, 548; platensis, 361, 362, 543; Portulacae, 361, 552; Tragopogonis, 361, 544. 546–549; **Trianthemae,** 361, 543
Alcicornium, 32
Algal periodicity in certain ponds and streams, 223
Alisma, 215–217, 224, 225; Plantago, 213, 217; Plantago-aquatica, 213; subcordatum, 62
Allionia incarnata, 543; nyctaginea, 543
Allium Cepa, 543
Alopecurus aristulatus, 472, 473; geniculatus, 472, 473; pratensis, 191, 473
Alsophila, 27
Amaranthus, 544; albus, 544; Bigelovii, 544; blitoides, 544; chlorostachys, 544; crispus, 544; emarginatus, 544; graecizans, 544; hybridus, 544; hybridus paniculatus, 544; Palmeri, 544; paniculatus, 544; retroflexus, 544; spinosus, 544; tristis, 544; viridis, 544
Amauroderma **asperulatum,** 407; **bataanense,** 407; **Clemensiae,** 408; Elmerianum, 408; **Ramosii,** 408
Ambrosia, 544; artemisiaefolia, 352, 544; psilostachya, 544; trifida, 352, 544
Amelanchier, 499
American botanical literature, Index to, (1907), 45; (1908), 91, 151, 219, 277; (1907), 315; (1908), 367, 417, 467, 513, 555; (1904–1907), 585
Ammophila, 56, 186; arenaria, 472
Ampelopsis quinquefolia, 544; Richii, 544; Veitchii, 544
Anabaena, 242, 247
Anacharis, 463; Alsinastrum, 461, 465; canadensis, 462, 465; Nuttallii, 461, 463, 465
Analogy between the development of the plates of crinoids and the leaves of Sassafras, 571
Anaphalis margaritacea, 352
Anaxagorea javanica, 66; **radiata** 66, 74
Anchistea virginica, 53
Andropogon, 147, 148, 353; abbreviatus, 182; furcatus, 182; littoralis, 182; **virginicus,** 147, 148, 182; scoparius, 148, 181; scoparius villosissimus, 181
Androsace officinalis, 552
Anemia, 27
Anemone, 552; acutiloba, 552, canadensis, 552; cylindrica. 352; dichotoma, 552; multifida, 552; nemorosa, 552; pennsylvanica, 552; quinquefolia, 552; virginiana, 552
Angiopteris, 27
Anoplolejeunea, 155, 165, 173–175; conferta 175–179; herpestica, 173, 175
Antennaria plantaginifolia, 546
Anthoxanthum odoratum, 190
Apalanthe, 463; Schweinitzii, 463, 465

Apples, The Fruit Spot of, 423
Arabis, 545; furcata, 545; glabra, 545; hirsutus, 545; Holboellii, 545; lyrata, 545; virginica, 545
Araucaria, 250–254, 256; Bidwilli, 250, 255, 257, 259, 260; **bladenensis,** 255, 257–259, 260; bohemica, 254; Cookii, 259; excelsa, 254; **Jeffreyi,** 258, 260; Toucasi, 257.
Araucarian remains from the Atlantic costal plain, 249
Araucarioxylon, 254
Araucarites, 254; ovatus, 253, 256, 260; **Zeilleri,** 252, 254, 259, 260
Archilejeunea, 155, 165, 168, 169, 171, 172, 174, 175; Auberiana, 168–171; conferta, 165, 176; Cruegeri, 168, 169; porelloides, 165, pseudo-cucullata, 165; Sellowiana, 173; **viridissima,** 169–171, 179; xanthocarpa, 165, 172
Arcyria denudata, 579; incarnata, 579
Areolaria, 295
Argemone platyceras, 363, 551
Aristida, 147, 148; dichotoma, 147, 148, 190, 353; gracilis, 190, 353; purpurascens, 148, 191
Aronia, 505, 508
Artemisia, 546; biennis, 546; canadensis, 546; ludoviciana, 546
Arthrospira, 248; Jenneri, 248
Aruncus, 541, 542; acuminatus, 542; Aruncus, 542; kamchaticus, 542; pubescens, 541; sylvestris americanus, 541
Asclepias syriaca, 352
Asparagus Sprengeri, 271, 275
Aspidium Boottii, 136; cristatum × spinulosum, 136; marginale, 18; spinulosum Boottii, 136
Asplenium, 27; ebenoides, 27, 135; Filix-foemina, 53; Filix-foemina angustum, 53; Filix-foemina Michauxii, 53; Filix-foemina rhaeticum, 53
Aster, 354, 358, 547; diffusus, 352; Novae-Angliae, 352, 546; oblongifolius, 546; sagittifolius, 547; vimineus, 352
Astilbe, 541
Astragalus, 358, 550; canadensis, 550; hastata, 548; lotiflorus, 550
Atlantic coastal plain, Some Araucarian remains from the, 249
Avena, 358
Azolla, 27

Bahamian species of Evolvulus, 89
Barbarea Barbarea, 545; vulgaris, 545
BARNHART, J. H. The published work of Lucien Marcus Underwood, 17
Basidiophora entospora, 546–548; Kellermanii, 544
Batatas edulis, 549
BERRY, E. W. Some Araucarian remains from the Atlantic coastal plain, 249
Beta vulgaris, 548
BICKNELL, E. P. The ferns and flowering plants of Nantucket, 49, 181, 471
Bicuculla, 550, 551; canadensis, 550; Cucullaria, 550
Bidens, 358; cernua, 547; chrysanthemoides, 547; comosa, 547; connata, 547; connata comosa, 547; frondosa, 343, 352, 547; laevis, 547; latifolia, 343; leucantha, 344; pilosa, 343, 344
Biographical sketch of Lucien Marcus Underwood, 1
Bjerkandera adusta, 391
Blechnum, 27
Blitum capitatum, 548
Blephariglottis Blephariglottis, 483
Boerhaavia anisophylla, 543; diffusa, 543; erecta, 543; hirsuta, 543; paniculata, 543; Sonorae, 543; spicata, 543; viscosa, 543; Xanti, 543
Boleti of the Frost herbarium, 517
Boletus affinis, 525; albus, 518; alveolatus, 518, 520; americanus, 520; ampliporus, 517; aureobrunneus, 525; auriporus, 518, 520, 521, 525; bicolor, 518, 522, 525; bovinus, 518; brevipes, 524; caespitosus, 521; canus, 525; castaneus, 518, 522; chromapes, 518; chrysenteron, 518, 524, 526; Clintonianus, 523–525; collinitus, 518; cyanescens, 519; decorus, 519; diffractus, 525; edulis, 519, 521, 522, 525; elbensis, 517; elegans, 519; eximius, 522; Farlowi, 525; felleus, 519, 521; ferrugineus, 519; firmus, 519; flavidus, 520, 521; flavo-aureus, 525; flavus, 520; Frostii, 520; glutinipes, 525; gracilis, 517, 526; graminicola, 525; graminis, 525; granulatus, 518, 520, 524; griseus, 520; innixus, 520; interruptus, 525; lenticularis, 525; limatulus, 521; luridus, 519, 521, 523, 524; luteus, 519–522; magnisporus, 521; miniato-olivaceus, 521; multipunctus, 522; Murraii, 521, 526; ornatipes, 519–522, 525; pallidus, 521; paludosus, 526; paluster, 517; Peckii, 521, 526; pictus, 521, 524, 526; piperatus, 521, 523; Ravenelii, 519, 522, 526; retipes, 519, 521, 522; robustus, 522; Roxanae, 522; rubeus, 522; rubripes, 526; Russellii, 522; salmonicolor, 522; Satanus, 523; scaber, 523, 524; serotinus, 523; sistotrema, 523; sordidus,

523, spadiceus, 523; speciosus, 523; Spraguei, 523, 524, 526; strobilaceus, 524; subchromeus, 522, 526; subreticulatus, 526; sulfureus, 522; sulfureus auricolor, 522; tenuiculus, 524; unicolor, 524; vermiculosus, 523; versipellis, 523, 524; vinaceus, 526; viridarius, 524; viscosus, 524
Botanical literature, American (1907), 45; (1908), 91, 151, 219, 277; (1907), 315; (1908), 367, 417, 467, 513, 555; (1904–1907), 585
Botrychium, 26–28, 30; obliquum, 52, 353; ternatum, 26; silaifolium, 32
Brachiolejeunea, 155, 157–159, 161, 162, 168; **bahamensis,** 383, 385, 386, 389; bicolor, 158, 159; chinantlana, 160, 386; corticalis, 158, 160, 164, 385; **densifolia,** 158, 160, 386; **insularis,** 159–161, 179, 386; latifolia, 155; sandvicensis, 157
Brachyphyllum, 250, 254
Brassica, 545; alba, 545; arvensis, 545, 546; campestris, 545; integrifolia, 545; nigra 545; oleracea, 545; sativa, 545; Sinapistrum, 545
Bremia Lactucae, 548, 549
BRITTON, N. L. Professor Underwood's relation to the work of the New York Botanical Garden, 39; Studies of West Indian plants, 337, 571; The generic name Bucida, 303; The genus Ernodea Swartz: a study of species and races, 203
Bromus, 533; hordeaceus, 200; racemosus, 200; secalinus, 200; sterilis, 200, 475; tectorum, 199, 200
BROOKS, C. The Fruit Spot of apples, 423
BROWN, H. B. Algal periodicity in certain ponds and streams, 223
Brunella vulgaris, 360
Bryonopsis laciniosa erythrocarpa, 549
Bryopteris, 157, 162
Buceras, 303
Bucida, 303; Buceras, 303, 305
Bucida, The generic name, 303
Bucida Buceras, The hypertrophied fruit of, 305
Bulbochaete, 234, 245; crenulata, 237, 245
Bursa Bursa-pastoris, 545
Bursera, 341; angustata, 342; glauca, 342; gummifera, 341; gummifera glabra, 341; gummifera pubescens, 341; inaguensis, 342; simplicifolia, 342

Cactus divaricatus, 564; repandus, 564
Caeoma, 506; Botryapites, 506; germinale, 506
Cakile americana, 545; edentula, 545
Caladium Colocasia, 544
Calamagrostis canadensis, 472; cinnoides, 472
Calandrinia Menziesii, 552
Callipteris, 27
Callitriche, 224
Calonyction aculeatum, 549
Calophyllum Inophyllum, 400
Caloplaca **amabilis,** 298; elegans **brachyloba,** 298
Calothrix parietina, 243, 248
Calvatia, 295; sculptum, 295
Calystegia Sepium, 549
Camelina microcarpa, 545; sativa, 545
Campanula, 358
Camptosorus, 27
Cantharellus, 27
Capnoides, 551; aureum, 550, 551; sempervirens, 550, 551
Capsella Bursa-pastoris, 545
Cardamine bulbosa, 545; hirsuta, 352, 545; laciniata, 545; ludoviciana, 545; rhomboidea, 545
Carduus arvensis, 547; lanceolatus, 547; muticus, 547; spinosissimus, 547; undulatus, 547
Carex, 262, 266, 267, 358, 471, 487, 490, 494; **abdita,** 492; adusta, 498; albicans, 490; albolutescens, 497; alpestris, 489; annectens, 492; aquatilis, 487; brunnescens, 496; bullata, 484; bullata Greenii, 484; canescens, 496; canescens alpicola, 496; canescens disjuncta, 495; canescens subloliacea, 496; **cephalantha,** 489, 493–495; cephalantha angustata, 494; **chihuahuensis,** 265; communis, 490; comosa, 485; costellata, 488, 489; costata, 488; cristata, 264; Davisii, 490; deflexa, 490; delicatula, 495; disjuncta, 495; echinata cephalantha, 493; Emmonsii, 489–491; festiva, 262; festucacea, 353; feta, 269; filiformis, 485, 486; **gigas,** 266–268; Goodenovii, 486–489; gynandra, 488; hirta, 486; hormathodes, 496, 497; hormathodes invisa, 496, 497; **incomperta,** 494; interior capillacea, 495; intumescens, 483; lagopina, 262; lagopodioides moniliformis, 264; lanuginosa, 485, 486; leporina, 261, 262; leporina americana, 261; leptalea, 492; Liddoni, 263, 264; lupulina, 484; lupulina pedunculata, 484; lurida, 353, 484; lurida flaccida, 484; marcida, 266; Muhlenbergii, 353, 493; muricata, 493; pallescens, 353, 489; pennsylvanica, 489; petasata, 261–263; phaeocephala, 261–263; physaema, 484; Preslii, 261, 262;

projecta, 264; pseudo-cyperus, 485; pseudoscirpoidea, 266–268; reducta, 264; rosea, 493; **scabriuscula,** 267, 286; **scirpiformis,** 267, 268, 270; scirpoidea, 266, 267, 269, 270; scirpoidea gigas, 268; scirpoidea stenochlaena, 269; scirpoides capillacea, 495; seorsa, 495; silicea, 497; stellulata cephalantha, 493; stellulata excelsior, 493; **stenochlaena,** 266, 267, 269; sterilis, 494, 495; stipata, 492; straminea, 496, 497; straminea alata, 498; straminea echinodes, 496, 497; stricta, 486; subloliacea, 496; tenuis, 489; **tonsa,** 492; tribuloides, 265; tribuloides moniliformis, 264; umbellata, 491, 492; umbellata brevirostris, 491; umbellata tonsa, 491, 492; utriculata, 484; utriculata minor, 484; varia, 490, 491; vestita, 485; virescens, 488, 489; virescens minima, 488; virescens Swanii, 488; vulgaris strictiformis, 487; vulpinoidea, 492; Walteriana, 485; xanthocarpa annectens, 492
Carex, Notes on, 261
Carica Papaya, 141, 145
Carica Papaya, Correlation of flower- and fruit-structure in, 141
Cassia, 397; marylandica, 352
Cassipourea, 339; alba, 339; elliptica, 339, 340; guianensis, 339; **subcordata,** 340; **subsessilis,** 340
Castalia ampla, 214; odorata, 217, 283, 284, 286, 287–289
Caudalejeunea, 162
Celastrus scandens, 352
Celtis occidentalis, 553
Cenchrus tribuloides, 190
Centaurea, 358, 547
Cephalocereus, 566
Cephalozia, 25
Cerastium, 543; cerastioides, 543; longipedunculatum, 543; nutans, 543; trigynum, 543; viscosum, 543; vulgatum, 543
Ceratites Botryapites, 506
Ceratopteris, 27; triangularis, 31
Cereus aggregatus, 84; coccineus, 84; conoideus, 86; cubensis, 562; divaricatus, 565; divergens, 565; erectus, 566; eriophorus, 562; gracilis, 563; monoclonos, 565; pellucidus, 562; phoeniceus, 84; phoeniceus conoideus, 86; polyacanthus, 85; repandus, 563, 564, 566; Roemeri, 86; subrepandus, 563; undatus, 564
Chaetochloa, 353, 552; glauca, 190, 552; italica, 190, 552; versicolor, 190; viridis, 190, 552
Chaetophora, 237–239, 244, 246; endiviaefolia, 239, 246; pisiformis, 229, 235, 238, 246
Chamaecrista, 352, 358
Chamaecyparis, 501; nootkatensis, 501; thyoides, 510, 511
Chamaeraphis, 552
Chamaesyce, 550; cordifolia, 550; glyptosperma, 550; hirtula, 550; humistrata, 550; serpens, 550; serpyllifolia, 550; stictospora, 550
Cheilanthes, 27
Cheilolejeunea, 378
Cheiranthus asper, 545; Cheiri, 545; pacificum, 545
Chenopodium, 548; album, 548; album viride, 548; hybridum, 548; leptophyllum, 548; rubrum, 548
Chloris elegans, 552
Chrysomyxa, 499
Cibotium, 27
Cichorium Intybus, 548
Cienkowskia reticulata, 577
Cinnamomum Heerii, 575
Cirsium, 358; arvense, 547
Citrullus vulgaris, 549
Cladium mariscoides, 483
Cladophora, 233, 234, 240, 246; glomerata, 229, 240, 244, 246
Cladothrox lanuginosa, 362, 544
Claviceps, 529, 533; purpurea, 533
Claytonia perfoliata, 552; virginica, 552
Clethra **Williamsii,** 73, 75
Closterium, 109, 110, 133, 232, 245; abruptum, 124; acerosum, 121, 227, 232–234, 245; acerosum elongatum, 122, 134; aciculare, 128, 134; acuminatum, 117; acutum, 128, 134; angustatum, 113; angustatum clavatum, 113, 133, 134; angustatum decussatum, 113; angustatum reticulatum, 113; Archerianum, 111, 134; arcuatum, 118; areolatum, 130; attenuatum, 127; Braunii, 130; Calamus, 131; calosporum, 118, 119; Cornu major, 124; costatum, 114, 134; costatum Westii 114, 134; Cucumis, 120, 245; Cynthia, 110, 133; decorum, 131, 134; decussatum, 133; Delpontei, 131; Dianae Dianae, 117, 118, 134, 245; Dianae arcuatum, 118; didymotocum, 111, 112, 134; didymotocum **Johnsonii,** 112; eboracense, 120; Ehrenbergii, 121, 134, 233, 245; Ensis, 111; gracile, 126; gracile elongatum, 126; gracile tenue, 126; incurvum, 119, 134; intermedium, 115; intervalicola, 131, 134; Jenneri, 119, 134; Johnsonii, 112; juncidum, 116, 134; juncidum brevius, 117, 134; juncidum elongatum, 117; Kützingii, 132, 134; lanceolatum, 122; Leibleinii, 120, 134;

Leibleinii curtum, 121; limneticum tenue, 126; lineatum, 129, 134; lineatum costatum, 129; littorale, 124, 134; Lunula, 122, 134; Lunula intermedium, 123; Lunula maximum, 123, 134; Lunula minor, 123; Lunula minus, 123; macilentum, 112, 134; maculatum, 130; Malmei, 111, 134; moniliferum, 121, 134; mourense, 131; nasutum, 133; **Novae-Angliae,** 131, 134; parvulum, 118, 134; praelongum, 125; Pritchardianum, 127, 134; pronum, 127, Pseudodianae, 118, 134; Ralfsii, 129; Ralfsii hybridum, 130, 134; Ralfsii immane, 130, 134; regulare, 114, 134; robustum, 121; rostratum, 132, 134; rostratum brevirostratum, 132; setaceum, 133, 134; strigosum, 125, 245; striolatum, 115, 134; striolatum elongatum, 116; striolatum erectum, 115, 134; striolatum intermedium, 115; subangustatum, 133; subangustatum clavatum, 133; subdirectum, 116; subtile, 126; subulatum, 128, 134; Toxon, 125, 134; tumidum, 124; turgidum, 127; turgidum intermedium, 127; Ulna, 116, 134; Venus, 119, 134
Closterium, The New England species of, 109
Cnicus, 547; arvensis, 547; horridulus, 547; lanceolatus, 547; muticus, 547
Coccinia indica, 549
Cochlearia Armoracia, 545; oleracea, 545
Coelastrum, 241, 247; microsporum, 247
Coleochaete, 245; scutata, 238, 245
Coleosporium Campanulae, 25
Colocasia Antiquorum, 544
Color variation in some of the fungi, 307
Coltricia **benguetensis,** 391
Columbea, 250, 253
Conocephalum, 325
Convolvulaceae, Studies in the North American, 97
Convolvulus, 549; altissimus, 99; Batatas, 549; bractiflorus, 100; eriospermus, 105; filiformis, 104; incanus, 549; macrorrhiza, 549; obvallatus, 100; racemosus, 99; repandus, 104; Sepium, 352, 549
Cook, M. T. The development of the embryo-sac and embryo of Potamogeton lucens, 209; The hypertrophied fruit of Bucida Buceras, 305
Cordyceps, 529, 532; militaris, 532; pistillariaeformis, 532
Coreopsis leucantha, 344
Coriolopsis aneba, 407; badia, 392; **bataanensis,** 393; caperata, 392; **Copelandi,** 392; dermatodes, 393; **melleoflava,** 393; occidentalis, 394; semilaccata, 394; **subcrocata,** 394
Coriolus atypus, 394; **Clemensiae,** 394; **Currani,** 395; elongatus, 395; maximus, 395; murinus, 395; nigromarginatus, 396; **perpusillus,** 396; prolificans, 396; **rubritinctus,** 396; **subvernicipes,** 397; versicolor, 403, 531
Cornucopiae hyemalis, 192
Cornus candidissima, 352
Coronopus, 545
Correlation of flower-and fruit-structure in Carica Papaya, 141
Corydalis, 551; aurea occidentalis, 551; glauca, 551
Cosmarium, 109, 234, 245; Botrytis, 245; laeve, 245; Phaseolus, 245; pyramidatum, 245
Crataegus, 350, 352, 354–357, 583; coloradensis, 581–583; macracantha occidentalis, 581, 582; ocidentalis, 581–583; spathulata, 503, 504
Crataegus, Two imperfectly known species of, 577
Crepis, 358
Crinoids, An analogy, 571
Crocus, 358
Crossotolejeunea, 373
Cryptogramma, 27
Cucumis angulatus, 549; Anguria, 549; dipsaceus, 549; erinaceus, 549; Melo, 549; odoratissimus, 549; sativus, 549
Cucurbita esculenta, 550; maxima, 550; ovifera, 550; Pepo, 550; verrucosa, 550
Cunninghamia, 253
Cunninghamites, 253; elegans, 253; squamosus, 253
Curtis, C. C. A biographical sketch of Lucien Marcus Underwood, 1
Cushman, J. A. The New England species of Closterium, 109
Cyathea, 27, 31
Cyathocalyx **acuminatus,** 66, 74; biovulatus, 67
Cyathula lappulacea, 544
Cyclomyces fuscus, 414
Cycloporellus **barbatus,** 397; cichoriaceus, 397; microcyclus, 397
Cylindrosporium, 452; **Pomi,** 446, 453; Ranunculi, 452
Cynoglossum officinale, 545
Cyperus anceps, 568; bromoides, 568; dentatus, 476; dentatus ctenostachys, 476; diandrus, 476; digitatus, 568; erythrorhizos, 478; esculentus, 477.

568; esculentus angustispicatus, 477; esculentus leptostachyus, 477; filiculmis, 353, 478; filiculmis macilentus, 478; granularis, 568; Grayi, 478; humilis, 568; **macilentus,** 478; Nuttallii, 476; oxylepis, 568; rivularis, 476; speciosus, 477; strigosus, 478; strigosus compositus, 478; strigosus robustior, 478; tetragonus, 568
Cyrtolejeunea, 165
Cyrtomium, *27*
Cystopteris, *27*

Dactylis glomerata, 196
Daedalea amanitoides, 405, 414; Hobsoni, 414; **isabellina,** 414; **subconfragosa,** 415
Dammara, *249*, *250*, *254*, *256*
Dammarites, *249*
Danaea, 30; alata, 382
Danthonia Alleni, 193; compressa, 475; Faxoni, 193; sericea, 193; spicata, 193
Daphne **luzonica,** *72*, *75*
Davallia, *27*
Dennstaedtia, *27*; punctilobula, 54
Dentaria, 546; diphylla, 545; heterophylla, 545; laciniata, 545; maxima, 545
Deparia, *27*
Deschampsia flexuosa, 193
Development of the embryo-sac of Nymphaea advena, 283
Development of the embryo-sac and embryo of Potamogeton lucens, 209
Development of the sexual organs and sporogonium of Marchantia polymorpha, 321
Dianthus, 358
Dibrachiella, 168, 169
Dicksonia, *27*
Dicranolejeunea, 178
Dictydiaethalium plumbeum, 578
Dictydium cancellatum, 578
Dictyogramma, *27*
Diderma crustaceum, 577
Didymochlaena, *27*
Didymium squamulosum, 578
Dicentra, 551
Diplachne **maritima,** 195; procumbens, 195
Diplazium, *27*
Dipsacus sylvestris, 550
Dipterocarpus, 409
Distichlis spicata, 196
Docidium, *245*; Trabecula, *234*, *245*
DODDS, G. S., & RAMALEY, F. Two imperfectly known species of Crataegus, 577
Dorstenia **jamaicensis,** 567
Doryopteris, *27*
Dothidea pomigena, 425
DOWELL, P. New ferns described as hybrids in the genus Dryopteris, 135
Draba caroliniana, 546
Draparnaldia, *237*, *238*, *246*; plumosa, *229*, *239*, *244*, *246*
Drosera filiformis, 55, 483
Drymoglossum, *27*
Drynaria, *27*
Dryopteris, *27*, *28*, 135; Boottii, 54, 136; Clintoniana, 137; **Clintoniana × Goldiana,** 137; **Clintoniana × intermedia,** 136; cristata, 54, 135–137; **cristata × intermedia,** 136, 137; cristata × marginalis, 135; cristata × spinulosa, 136; Filix-mas × spinulosa, 135; Goldiana, 139; Goldiana celsa, 137, 138; **Goldiana × intermedia,** 138; **Goldiana × marginalis,** 139; intermedia, 54, 137, 139; marginalis, 135, 139; marginalis × spinulosa, 135; noveboracensis, 53; pittsfordensis, 135; simulata, 53, 54; spinulosa, 54, 136; Thelypteris, 53
Dryopteris, New ferns described as hybrids in the genus, 135
Dulichium arundinaceum, 479
DURAND, E. J. The development of the sexual organs and sporogonium of Marchantia polymorpha, 321

Earliella corrugata, 398
Echinella acuta, 128
Echinocerei of New Mexico, 77
Echinocereus coccineus, 77–82, 84; conoideus, 78–81, 84–86; **neo-mexicanus,** 84, 86, 87; phoeniceus conoideus, 86; polyacanthus, 78–81, 83–85
Echinochloa Crus-galli, 183; Crus-galli mutica, 183; Walteri, 183
Echinocystis lobata, 550
Echinospermum Redowskii cupulatum, 545; Redowskii occidentale, 545
Elaeocarpus tuberculatus, *72*; **venosus,** *71*, *75*
Eleocharis, *224*, *225*, *236*; acicularis, 480; capillacea, 569; glaucescens, 479, 480; obtusa, 353, 479; palustris, 479, 480; rostellata, 480; tenuis, 480; tricostata, 480
Elfvingia Elmeri, 409; tornata, 409
Elodea, 457; canadensis, 457–461, 463, 465; latifolia, 463, 465; Planchonii, 462, 465; Schweinitzii, 463, 465
Elymus **halophilus,** 201; hirsutiglumis, 201; virginicus, 201
Embryo-sac of Nymphaea advena, The development of the, 283
Embryo-sac and embryo of Potamo-

geton lucens, The development of the, 209
Encrinus liliiformis, 571, 572
Epicostorus, 535
Equisetum, 24; arvense, 54, 353; fluviatile, 54; variegatum, 19
Eragrostis major, 195; pectinacea, 195, 353; Purshii, 195, 353; spectabilis, 196
Erechtites hieracifolia, 547
Erigeron, 547; annuus, 547; canadensis, 547; philadelphicus, 547; ramosus, 352, 547
Eriogynia, 541
Eriophorum gracile, 482; tenellum, 482; virginicum, 482; virginicum album, 482; viride-carinatum, 482
Eriophyes, 305, 306
Ernodea, 203; angusta, 203, 204, 206, 207; Cokeri, 203, 204, 207, 208; littoralis, 203, 204, 206–208; **Millspaughii,** 204, 207; **Nashii,** 204, 208; **Taylori,** 204, 208
Ernodea Swartz, The genus: a study of species and races, 203
Erysimum, 358
Eucaloplaca, 298
Euglena viridis, 227
Euleptogium, 299
Euosmolejeunea, 378
Eupatorium ageratoides, 547; purpureum, 547
Euphorbia, 358, 363, 550; glyptosperma, 363; hirsuta, 550; hypericifolia, 550; maculata, 363, 550; Preslii, 352, 550
Euphrasia, 358
Eutacta, 250, 253, 259
Euthamia caroliniana, 352; graminifolia, 352
EVANS, A. W. Hepaticae of Puerto-Rico, 155; New West Indian Lejeuneae, 371
Evolvulus Arbuscula, 89; **bahamensis,** 89; **Bracei,** 90; incanus, 90; purpureo-coeruleus, 89; squamosus, 89; Wrightii, 90
Evolvulus, Two Bahamian species of, 89
Exogonium, 97; arenarium, 98, 104; argentifolium, 97, 98, 102; bracteatum, 98, 100; bracteatum **pubescens,** 101; **Conzattii,** 98, 102; **cubense,** 98, 105; **Eggersii,** 98, 104; eriospermum, 98, 105; filiforme, 98, 104; **fuchsiodes** 98, 101; **jalapoides,** 98, 101; **leuconeurum,** 98, 106; **luteum,** 98, 103; **microdactylum,** 98, 101, 102; microdactylum **integrifolium,** 103; Olivae, 100; pedatum, 98, 106; racemosum, 98, 99; repandum, 98, 104; Rudolphii, 98, 99; spicatum, 100; **velutifolium,** 98, 100; **viridiflorum,** 98, 106; **Wrightii,** 98, 99
Exogonium, The genus, 97

Favolus philippinensis, 401; **resinosus,** 398; **subrigidus,** 398; tenuis, 399; transiens, 397; Wightii, 399
Ferns described as hybrids in the genus Dryopteris, New, 135
Ferns and flowering plants of Nantucket, 49, 181, 471
Festuca, 358; capillata, 198; duriuscula, 199, 475; elatior, 199; Myuros, 198; octoflora, 197; ovina, 198, 199, 475; ovina duriuscula, 199; pratensis, 199; rubra, 198, 199
Fimbriaria, 324
Fimbristylis autumnalis, 353, 569
Floerkea proserpinacoides, 551
Flower- and fruit-structure in Carica Papaya, Correlation of, 141
Flowering plants of Nantucket, 49, 181, 471
Fomes Auberianus, 409; ligneus, 409; luzonensis, 409; pyrrhocreas, 411; **subresinosus,** 410; substygius, 412; **subungulatus,** 410; ungulatus, 409; Warburgianus, 407
Fossombronia, 24
Fragaria americana, 352; virginiana, 352
Franseria discolor, 544; tenuifolia, 544
Freycinetia Cumingiana, 64; luzonensis, 64
Froelichia campestris, 362, 544; floridana, 362, 544; gracilis, 362, 544
Frost herbarium, The Boleti of the, 517
Fruit of Bucida Buceras, The hypertrophied, 305
Fruit Spot of apples, 423
Fruit-structure in Carica Papaya, Correlation of flower- and, 141
Frullania, 157, 385, 386
Frullanoides densifolia, 158, 159
Frustularia subulata, 128
Fuligo ovata, 578
Fumaria, 358
Funalia funalis, 399; leonina, 399; philippinensis, 399; villosa, 399
Fungi, Color variation in some of the, 307
Fusarium, 529
Fusicladium dendriticum, 424

Gaertneria acanthocarpa, 544; discolor, 544

Galium, 358, 553; Aparine, 553; boreale, 553; lanceolatum, 553; triflorum, 553
Ganoderma amboinense, 410; **balabacense,** 410; **Currani,** 411; subtornatum, 409
Gasparrinia, 298
Gaura parviflora, 551
Generic name Bucida, The, 303
Genus Dryopteris, New ferns described as hybrids in the, 135
Genus Ernodea Swartz: a study of species and races, The, 203
Genus Exogonium, The, 97
Genus Gymnosporangium, Studies in the, 499
Geranium, 551; carolinianum, 551; dissectum, 551; maculatum, 551; pusillum, 551; Richardsonii, 551; Robertianum, 551
Geum album, 552; canadense, 552; macrophyllum, 553; rivale, 553
Gibberella, 528, 529; pulicaris, 529
Gilia, 552
Gleichenia, 28
Gloecystis, 247; gigas, 247
Gloeophyllum edule, 415; **nigrozonatum,** 415; striatum, 416
Glyceria fluitans, 196; septentrionalis, 196
Gnaphalium obtusifolium, 352; purpureum, 547; spathulatum, 547
Gomphostrobus, 250
Goniopteris, 28
Gonium, 241, 246; pectorale, 246
Gonolobus, 544; macrophyllus, 544; suberosus, 544
Grasses from the West Indies, Two new, 301
Grossularia divaricata, 551; oxyacanthoides, 551; rotundifolia, 551
Gymnogramma, 28
Gymnogramme, 30
Gymnosporangium, 25, 499–502, 504, 505; aurantiacum, 509; Betheli, 510; bermudianum, 502, 509; biseptatum, 506; Botryapites, 506, 510; clavariaeforme, 504, 510; clavipes, 506; **Davisii,** 507, 511; durum, 510; Ellisii, 505, 510, 511; **exiguum,** 508, 511; flaviforme, 504; flaviformis, 504; **floriforme,** 503, 504, 510; floriformis, 504; germinale, 506, 510; globosum, 510; inconspicuum, 508, 511; juniperinum, 505, 510; Juniperi-virginianae, 502; **Libocedri,** 509, 511; macropus, 502; Nelsoni, 508, 511; Nidus-avis, 510, 511; speciosum, 505, 510; tremelloides, 505
Gymnosporangium, Studies in the genus, 499
Hapalopilus gilvus, 399; licnoides, 399; malaiensis, 400; **Ramosii,** 400; subrubidus, 400
Harpalejeunea, 375, 377–379; **reflexula,** 375, 376, 389; subacuta, 377, 379, 380; uncinata, 376, 377
HARPER, R. M. Some native weeds and their probable origin, 347
Harrisia, 561; **Brookii,** 562, 564; **eriophorus,** 561, 562; **Fernowi,** 561, 562; **gracilis,** 561, 564; **Nashii,** 562, 564; **portoricensis,** 561, 563; **Taylori,** 562, 565; **undata,** 562, 564
HARSHBERGER, J. W. The water-storing tubers of plants, 271
Hartmannia speciosa, 551
Hedeoma hispida, 551
Helianthus, 547; annuus, 547; divaricatus, 547; doronicoides, 547; grosseserratus, 547; hirsutus, 547; occidentalis, 547; Maximiliani, 547; scaberrimus, 547; strumosus, 547; tracheliifolius, 547; tuberosus, 547
Hemionitis, 28
Hemitelia, 28
Hemitrichia clavata, 579; vesparia, 579
Heppia **placodizans,** 299; **desertícola,** 300; Hassei, 300; leptopholidis, 300
Hepatica acuta, 552; acutiloba, 552; Hepatica, 552; triloba, 552
Hepaticae of Puerto Rico, 155
Hernandia, 337, 338; cubensis, 338; guianensis, 338; **jamaicensis,** 338; sonora, 338; sonora guadeloupensis, 338
Herposteiron, 238, 245
Hesperis matronalis, 546
Hexagona cucullata, 400; **luzonensis,** 401; **pertenuis,** 401; philippinensis, 401
Hieracium, 358
Holcus lanatus, 193
Homalocenchrus oryzoides, 190
Hordeum jubatum, 476; vulgare, 201
HOUSE, H. D. Studies in the North American Convolvulaceae, 97; Two Bahamian species of Evolvulus, 89
Houstonia coerulea, 352; minor, 553; patens, 553
HOWE, M. A. Lucien Marcus Underwood: a memorial tribute, 13
Humata, 28
HUMPHREYS, E. W. An analogy, between the development of the plates of crinoids and the leaves of Sassafras, 577
Hyalotheca, 234, 245
Hybrids in the genus Dryopteris, New ferns described as, 135

Hydrophyllum macrophyllum, 551; virginicum, 551
Hymenophyllum, 28
Hyoscyamus, 364
Hypericum maculatum, 352; mutilum, 352
Hypertrophied fruit of Bucida Buceras, 305
Hypocrea, 311, 528, 532; apiculata, 311, 313; chlorospora, 310, 311, 313; citrina, 313, 532; gelatinosa, 310, 311, 313; patella, 532; Richardsoni, 532; rufa, 532; tubercullariformis, 530; viridis, 311
Hypocreales, Some North Dakota, 527
Hypolepis, 28
Hypomyces, 528, 531; aurantius, 531; lactifluorum, 312, 313, 531; ochraceus, 531; polyporinus, 531; purpureus, 312, 313, 531; rosellus, 531

Ibidium Beckii, 52
Icotorus, 535
Ilysanthes gratioloides, 352
Impatiens, 545; aurea, 545; biflora, 545; fulva, 545; pallida, 545
Index to American botanical literature (1907), 45; (1908), 91, 151, 219, 277; (1907), 315; (1908), 367, 417, 467, 513, 555; (1904–1907), 585
Inonotus **Clemensiae,** 401; fruticum, 402
Ipomoea, 97; alterniflora, 105; altissima, 99; arenaria, 104; argentifolia, 102; Batatas, 549; bracteata, 97–100; bracteata pubescens, 101; Carolina, 549; cincta, 100; commutata, 549; Conzattii, 102; Desrousseauxii, 105; eriosperma, 105; filiformis, 104; fuchsioides, 101; fuchsioides glabra, 101; fuchsioides parviflora, 101; hederacea, 549; incarnata, 549; jalapoides, 101; lacunosa, 549; leptophylla, 549; leuconeura, 106; mexicana, 549; microdactyla, 102; nematoloba, 107; obtusata, 105; pandurata, 549; Pes-caprae, 549; praecox, 102; Purga, 97; purpurea, 549; racemosa, 99; repanda, 103, 104; rubrocincta, 106; Rudolphii, 99; spicata, 100; Steudeli, 104; tamnifolia, 549; trichocarpa, 549; triloba, 549; viridiflora, 106
Isactis caespitosa, 243, 248
Isaria farinosa, 532
Isidorea, 203
Isnardia palustris, 352
Isoetes, 20, 55; echinospora Braunii, 55
Iva ambrosiaefolia, 544; ciliata, 547; xanthifolia, 544
Ixophorus, 552

Jackson, H. S. Sorosporium Ellisii Winter, a composite species, 147
Jacquemontia tamnifolia, 549
Juncus, 358; bufonius, 353; effusus, 353; marginatus, 353; tenuis, 353
Jungermannia bicolor, 158, 159; conferta, 175; polycarpa, 162; xanthocarpa, 175
Juniperus, 501; communis, 353, 510; communis alpina, 507; communis canadensis, 353; nana, 507; sabinoides, 508; sibirica, 507, 510, 511; virginiana, 58, 503, 508

Kelseya, 540, 541
Kern, F. D. Studies in the genus Gymnosporangium, 499
Kneiffia pumila, 352
Knoxia, 204
Koellia virginiana, 352
Koniga maritima, 546
Krigia Dandelion, 548; virginica, 352
Kyllinga intermedia, 568; peruviana, 568

Literature, American Botanical (1907), 45; (1908), 91, 151, 219, 277; (1907), 315; (1908), 367, 417, 467, 513, 555; (1904–1907), 585
Lobelia inflata, 352
Lolium italicum, 200, 476; perenne, 200, 475
Lomaria, 28
Lophanthus, 551
Lopholejeunea, 162
Lorinseria areolata, 52
Loxoscaphe, 28
Lunulina monilifera, 121
Luetkea, 541
Lutkea, 541
Lycogala epidendrum, 579
Lycoperdon, 293, 295; caelatum, 295; insculptum, 291; sculptum, 293, 294
Lycoperdon sculptum Harkness, Notes on, 291
Lycopersicon Lycopersicon, 553
Lycopodium, 28, 32; adpressum, 55; alopecuroides, 55, 483; complanatum, 55; inundatum Bigelovii, 55; obscurum, 55; tristachyum, 29, 55
Lyngbya, 247; Juliana, 247; ochracea, 247
Lenzites **Clemensiae,** 416; **submurina,** 416
Lepidium campestre, 546; densiflorum, 546; incisum, 546; intermedium, 546; sativum, 546; virginicum, 352, 546
Leptilon canadense, 352, 547
Leptogium **arizonicum,** 299

Lespedeza, 358, 352
Leucolejeunea, 155, 165, 171, 174, 178; clypeata, 171, 177; unciloba, 172, 173; xanthocarpa, 172, 173, 179; conchifolia, 173
Leucoporus hirto-lineatus, 401
Leucostegia, 28
Libocedrus, 501, 509; decurrens, 511
Lichens, New North American, 297
Limnocharis, 215; emarginata, 214, 217
Linaria canadensis, 352, 553
Lindsaea, 33
Linum sulcatum, 551
Liriodendron, 575
Lactaria, 312
Lactuca altissima, 548; canadensis, 352, 548; hirsuta, 548; integrifolia, 548; leucophaea, 548; ludoviciana, 548; pulchella, 548; sagittifolia, 548; sativa, 548; spicata, 548, 549
Laetiporus speciosus, 402
Lagenaria vulgaris, 550
Lamium amplexicaule, 551
Laportea canadensis, 553
Lappula cupulata, 545; floribunda, 545; occidentalis, 545; texana, 545
Larix decidua, 57
Lastraea, 28
Lechea maritima, 52
Legnotis, 339; elliptica, 339; Cassipourea, 339
Leiolejeunea, 377, 378; **grandiflora,** 378, 379, 389
Lejeunea, 21, 157, 162, 377, 383, 385; asperrima, 375; atroviridis, 165; bicolor, 159; conferta, 174, 175; conferta Miquelii, 177; conferta Liebmaniana, 177; cyclostipa, 169; domingensis, 162, 164; florentissima, 169, 171; herpestica, 175; holostipa, 165; involutiloba, 175; linguaefolia, 164; Miquelii, 175; polycarpa, 162; proteoides, 175; stricta, 377; subaurita, 175; unciloba, 169, 173; viridissima, 169; xanthocarpa, 172
Lejeuneae, New West Indian, 371

MACKENZIE, K. K. Notes on Carex, 261
Madia sativa, 547
Malache, 344; scabra, 344, 345; **troyana,** 345
Malus Malus, 453
Mammillaria aggregata, 84
Marattia, 28
Marchantia, 322–325, 327, 328; polymorpha, 322, 332
Marchantia polymorpha, The development of the sexual organs and sporogonium of, 321
Marchesinia, 155, 158
Marsilia, 19
Mastigolejeunea, 156, 161, 168
Matricaria matricariodes, 547
Matteuccia, 28
Medicago sativa, 550
Megapterium missouriense, 551
Melothria scabra, 550
Memorial tribute: Lucien Marcus Underwood, 13
Meniscium, 28
Mentha, 360; canadensis, 352
Merismopedia, 248; convoluta, 248
Mesocarpus parvulus, 231; radicans, 231; scalaris, 232
Micrampelis echinata, 550; lobata, 550
Microlepia, 28
Microporellus dealbatus, 402; subdealbatus, 402
Microzamia dubia, 253, 260
Mitrephora ferruginea, 67; Lanotan, 67; **Merrillii,** 67; **Williamsii,** 68, 74
Mohria, 28
Momordica balsamina, 550; Charantia, 550
Monoon, 68
Monotropella, 168
Montia perfoliata, 552
Mougeotia, 231, 244; genuflexa, 232, 244; parvula, 232, 244; scalaris, 232, 244
Moulds, North Dakota slime-, 577
Muhlenbergia mexicana, 191, 353; diffusa, 191
Mukia scabrella, 550
Mulgedium leucophaeum, 549
MURRILL, W. A. Additional Philippine Polyporaceae, 391; The Boleti of the Frost herbarium, 517
Myosotis verna, 545
Myxonema, 238, 239, 246; nanum, 239, 243, 246; tenue, 239, 246

Nabalus albus, 549; altissimus, 548, 549
Nageiopsis, 256, 257; montanensis, 256, 257; ovata, 256, 257; zamioides, 257
Naias, 60, 215, 217; flexilis, 60, 214; guadalupensis, 60, 61; microdon, 60
NASH, G. V. Two new grasses from the West Indies, 301
Nantucket, The ferns and flowering plants of, 49, 181, 471
Nasturtium, 546
Native weeds and their probable origin, 347
Nectria, 528, 529; cinnabarina, 308, 530; coccinea, 529; episphaeria, 529; Meliae, 310, 313; nigrescens, 309, 313; offuscata, 309, 313; Peziza, 529; purpurea, 308–310, 313, 530, 531;

Russellii, 309, 313; sanguinea, 529; tuberculariformis, 528, 529; verrucosa, 530
Neillia opulifolia multiflora, 536
Nelumbo, 283, 284, 289
Nephrocytium, 247; Agardhianum, 247
Nephrodium, 28; esculentum, 272
Nephrolepis, 28, 272–274; acuminata, 271; cordifolia, 271–273, 275; cordifolia etuberosa, 273; cordifolia tuberosa, 273; davallioides, 271, 273; exaltata, 271, 272; hirsutula, 272, 273; pectinata, 272; philippinensis, 271–273; Pluma, 272, 273; Pluma Bausei, 272; tuberosa, 271, 272, 275; undulata, 272
Neslia paniculata, 546
New England species of Closterium, 109
New ferns described as hybrids in the genus Dryopteris, 135
New grasses from the West Indies, 301
New Mexico, Some Echinocerei of, 77
New North American lichens, 297
New West Indian Lejeuneae, 371
New York Botanical Garden, Professor Underwood's relation to the work of the, 39
Nicotiana glauca, 364, 553; longiflora, 364
Nigrofomes melanoporus, 411
Nigroporus durus, 402; vinosus, 402
Niphobolus, 29
North American Convolvulaceae, 97
North American lichens, New, 297
North American Peronosporales, 361, 543
North Dakota Hypocreales, 527
North Dakota slime-moulds, 577
Nostoc, 242, 247; commune, 242, 247; verrucosum, 242, 243, 247
Notes on Carex, 261
Notes on Lycoperdon sculptum Harkness, 291
Notes on Philotria Raf., 457
Notes on Rosaceae, 535
Notholaena, 28
Nymphaea, 213, 284, 289; advena, 217, 283, 284, 289
Nymphaea advena, The development of the embryo-sac of, 283
Odontolejeunea, 381, 382; **longispica,** 380–383, 389; lunulata, 381–383; Sieberiana, 381–383
Oedogonium, 234, 237, 245; crassiusculum, 235, 237, 238, 245; cryptoporum, 227, 236, 245
Oenothera, 355, 551; biennis, 352, 551; laciniata, 551; missouriensis, 551; sinuata, 551; speciosa, 551
Oligonema flavidum, 580
Onagra biennis, 551
Onoclea, 28; sensibilis, 54; sensibilis obtusilobata, 18
Onychium, 28
Ophiocytium, 247; bicuspidatum, 247
Ophioglossum, 28; arenarium, 52; vulgatum, 51, 52
Panicum, 186–188, 353, 354, 358; agrostoides, 184; anceps, 184; atlanticum, 189; Bicknellii, 186; boreale, 189; capillare, 184; clandestinum, 189; Clutei, 189; columbianum, 187; depauperatum, 184–186; dichotomum, 186; filiculme, 187, 188; **Grisebachii,** 301; lineariifolium, 185, 186; martinicense, 301; mattamusketense, 189; meridionale, 187, 188; miliaceum, 184; oricola, 187; **Owenae,** 185; proliferum, 184; Scribnerianum, 189; sphaerocarpon, 189; tennesseense, 188; unciphyllum, 188; unciphyllum thinium, 188; virgatum, 184
Papaver, 364
Parietaria pennsylvanica, 553
Parthenium integrifolium, 547; repens, 548
Parthenocissus quinquefolia, 554; tricuspidata, 554
Paspalum Muhlenbergii, 183; prostratum, 182; psammophilum, 182; pubescens, 183; setaceum, 182
Passiflora ciliata, 343; foetida, 343
Pavonia, 345; racemosa, 344; racemosa troyana, 345; spicata, 344; spinifex, 345
Pediastrum, 241, 246; Boryanum 246
Pellaea, 28
Peltolejeunea, 178
Penium, 245; interruptum, 234, 245
Peperomia, 567
Opulaster, 535, 536, 537; alabamensis, 536, 537; alternans, 538; australis, 536, 537; bracteatus, 536; bullatus, 535; capitatus, 536, 537; cordatus, 536, 537; Hapemanii, 536–538; intermedius, 536, 537; malvaceus, 536–538; monogynus, 536–538; opulifolius, 536, 537; pauciflorus, 538; pubescens, 536; Ramaleyi, 536; stellatus, 536, 537
Origin, Some native weeds and their probable, 347
Orobanche, 358
Oscillatoria, 242, 247; Froelichii, 243; Imperator, 243; limosa, 242, 243, 247; princeps, 242, 243, 247; tenuis, 242, 247
Osmunda, 28; cinnamomea, 52; Claytoniana, 52; spectabilis, 52
Oxalis, 352, 358

Oxybaphus nyctagineus, 543
Pachyphyllum araucarinum, 257; rigidum, 257
Pagiophyllum, 257
Pandanus **glauciphyllus,** 64, 74; polycephalus, 65
Pandorina, 241, 246; Morum, 246
Panicularia acutiflora, 197; americana, 196; canadensis, 196; fluitans, 196; nervata, 196; pallida, 196; **septentrionalis,** 196
Peridermium, 25, 506; germinale, 506
Periodicity in certain ponds and streams, Algal, 223
Peronospora, 363, 364; Alsinearum, 543; alta, 552; arborescens, 363, 364, 551; Arenariae macrospora, 543; Arthurii, 551; calotheca, 553; candida, 552; Claytoniae, 552; Corydalis, 363, 364, 550, 551; Cynoglossi, 545; Cyparissiae, 363; Dipsaci, 550; dubia, 364; Echinospermi, 545; effusa, 548; Euphorbiae, 363, 550; Ficariae, 552; Floerkeae, 364, 551; Giliae, 552; grisea, 553; Hedeomae, 551; Hydrophylli, 551; Hyoscyami, 364; leptosperma, 546; Linariae, 553; Lini, 551; Lophanthi, 551; Myosotidis, 545; Nicotianae, 364, 365, 553; Oxybaphi, 543; parasitica, 545, 546; phloginia, 552; Plantaginis, 552; Polygoni, 363, 552; Potentillae, 552, 553; Rumicis, 363; Rubi, 553; Schleideni, 543; Seymourii, 553; sordida, 553; sparsa, 553; trichomata, 544; Trifoliorum, 550; Urticae, 553; Viciae, 550; Violae, 554; Whippleae, 553
Peronosporales, North American, 361, 543
Petrophytum, 538, 540, 541; caespitosum, 541; elatior, 541
Peziza, 529
Phalaris canariensis, 194; arundinacea picta, 194
Phanerophlebia, 27
Pharbitis bracteata, 99
Pharus **parvifolius,** 301; glaber, 302
Phaseolus lunatus, 550
Phegopteris, 28
Phellorina, 294
Philippine Polyporaceae, 391
Philotria, 457; angustifolia, 460–465; canadensis, 458, 459, 464, 465; linearis, 464, 465; minor, 462, 464, 465; Nuttallii, 461, 464, 465; Planchonii, 462, 464, 465
Philotria Raf., Notes on, 457
Phleum pratense, 191
Phlox divaricata, 552
Phormidium incrustatum cataractorum, 248; tenue, 248
Phragmicoma, 161; affixa, 382, 383; aulacophora, 161; bicolor, 159, chinantlana, 160; polycarpa, 162
Phragmidium Libocedri, 509
Phragmites Phragmites, 195
Phyllachora pomigena, 427
Phyllitis, 28
Phymatodes, 28
Physarum contextum, 578
Physocarpa, 535
Physocarpon, 535
Physocarpum, 535
Physocarpus, 535; michiganensis, 536; missouriensis, 536
Phytolacca decandra, 350
Phytophthora Cactorum, 553; infestans, 553; Phaseoli, 550; Thalictri, 363, 552
Pilocereus divaricatus, 565
Pilularia globulifera, 20
Pinus caribaea, 206; insularis, 392, 405, 410; Pumilio, 57; rigida, 55, 57; sylvestris, 57
Piper, 566, 567; peltatum, 556, 567; peltatum hirtellum, 566; umbellatum, 566
Pisonia longirostris, 65
Pistacia Simaruba, 341
Pisum sativum, 550
Placoheppia, 300
Plantago aristata, 552; lanceolata, 552; major, 352, 552; patagonica aristata, 552; Rugelii, 352, 552; virginica, 552
Plants of Nantucket, The ferns and flowering, 49, 181, 471
Plants, Studies of West Indian, 337, 561
Plants, The water-storing tubers of, 271
Plasmopara pygmaea, 552
Platanus, 575
Platycrinus hemisphericus, 572
Platylejeunea, 174, 175; Kroneana, 387, 388
Pleonectria, 528, 530; berolinensis, 530
Pleurocarpus mirabilis, 232, 244
Pleurococcus, 246; vulgaris, 246
Poa, 358; annua, 196; compressa, 196; fasciculata, 197; pratensis, 196; serotina, 196; trivialis, 196, 475
Podisoma gymnosporangium clavipes, 506
Podocarpus Blumei, 63; latifolia, 63
Podozamites acutus, 257; lanceolatus, 257
Poecilopteris crenata, 33
Polyalthia, 68; **clusiflora,** 68
Polygala verticillata, 352

Polygonum, 358, 363; aviculare, 352, 363, 552; dumetorum, 363, 552; erectum, 352; Hydropiper, 352; pennsylvanicum, 352; sagittatum, 352; scandens, 352, 363, 552
Polypodium, 28; vulgare, 22
Polyporaceae, Additional Philippine, 391
Polyporus Adami, 402; asper, 392; badius, 402; brunneopictus, 392; caperatus, 392; carneo-niger, 402; celebicus, 402, 403; coracinus, 403; Dybowski, 399; elegans, 403; fissus, 403; flabelliformis, 403; grammocephalus, 401, 403; Hasskarlii, 412; lucidus, 24; ochrocroceus, 411; palensis, 403; Perula, 402, 403; Philippinensis, 401; rasipes, 402; squamaeformis, 392; strigatus, 392; xeranticus, 393
Polystichum, 28
Polystictus malacensis, 400; malaiensis, 400; Möllerianus, 402; xerampelinus, 397
Pontederia, 58
Populus tremuloides, 532
Porella, 226
Portulaca oleracea, 552
Potamogeton, 224, 236; diversifolius, 59; foliosus, 209, 214–216; lucens, 213–215; mysticus, 59; natans, 209, 214–217; Nuttallii, 59; Oakesianus, 59; pauciflorus, 214; pectinatus, 59; perfoliatus, 59; pulcher, 59; pusillus, 59
Potamogeton lucens, The development of the embryo-sac and embryo of, 209
Potentilla, 358; grandiflora, 553; monspeliensis, 553; nepalensis, 553; norvegica, 553; simplex, 352
Potomorphe, 566, 567; peltata, 566; umbellata, 566
Prenanthes altissima, 549
Prionolejeunea, 374, 375
Protococcus gigas, 235
Protodammara, 249, 254
Prunella vulgaris, 352
Pseudo-araucaria, 254
Pseudoperonospora celtidis, 553; cubensis, 549, 550
Pteridium, 28; aquilinum, 52; aquilinum latiusculum, 52
Pteris, 28
Ptilimnium capillaceum, 352
Ptychanthoides, 161, 162
Ptychanthus, 178
Ptychocoleus, 155, 158, 161, 162, 165, 168; aulacophorus, 161; densifolius, 159; polycarpus, 161, 162, 164, 165, 179; torulosus, 165
Puccinellia, 197; airoides, 475; distans, 197, 475; fasciculata, 475; maritima, 197
Puccinia Botryapites, 506; clavipes, 506
Puerto Rico, Hepaticae of, 155
Putoria, 203
Pycnolejeunea Schwaneckei, 173
Pycnoporus sanguineus, 404
Pyropolyporus albomarginatus, 411; caliginosus, 412; endotheius, 412; fastuosus, 412; lamaensis, 412; pectinatus, 412; **subextensus,** 413; **tenuissimus,** 413; **tricolor,** 413; Williamsii, 412
Pyrus, 505; arbutifolia, 505

Quamoclit Quamoclit, 549; vulgaris, 549

Races, The genus Ernodea Swartz: a study of species and, 203
Radula Grevilleana, 382
RAMALEY, F., & DODDS, G. S. Two imperfectly known species of Crataegus, 577
Ranunculus, 358; abortivus, 352, 552; acris, 452, 552; bulbosus, 452, 552; fascicularis, 552; pennsylvanicus, 552; recurvatus, 552; repens, 552; septentrionalis, 552
Raphanus sativus, 546
Resolutions adopted by the Torrey Botanical Club and other scientific organizations in relation to the death of Lucien Marcus Underwood, 41
Rhus typhina, 352
Rhysotheca australis, 550; Geranii, 551; Gonolobi, 544; Halstedi, 544, 546–548; illinoiensis, 553; obducens, 545; ribicola, 551; Umbelliferarum, 544; Viburni, 546; viticola, 554
Ribes albinervium, 551; divaricatum, 551; glandulosum, 551; hirtellum, 551; oxyacanthoides, 551; prostratum, 551; rotundifolium, 551; rubrum subglandulosum, 551; triste, 551
Riccia, 23, 24
Riella, 30
Rigidoporus surinamensis, 404
Rivea bracteata, 99
ROBINSON, C. B. Alabastra philippinensia, 63
Roestelia, 499, 501, 502, 504–506, 508; aurantiaca, 506; Botryapites, 506; cornuta, 505, 507, 508; Ellisii, 506; flaviformis, 504; floriformis, 504; penicillata, 501, 505; transformans, 505
Roripa, 546; Armoracia, 546; hispida, 546; obtusa, 546; palustris, 546; sessiliflora, 546; sinuata, 546; Walteri, 546

Rosa, 358; californica, 553
Rosaceae, Notes on, 535
Rubus, 352, 354, 356, 358, 360; Baileyanus, 553; canadensis, 553; nigrobaccus, 553; occidentalis, 553; procumbens, 553; strigosus, 553; triloba, 548; villosus, 553; villosus humifusus, 553
Rudbeckia fulgida, 548; laciniata, 548
Rumex, 363; Acetosella, 352
Ruppia maritima, 59, 60
RYDBERG, P. A. Notes on Philotria Raf., 457; Notes on Rosaceae, 535
Rynchospora alba, 483; glomerata, 483; jubata, 569; Torreyana, 483

Sabia **philippinensis** 70, 74; Swinhoei, 71
Sabina, 501; barbadensis, 509; bermudiana, 509; monosperma, 510; pachyphlaea, 510, 511; sabinoides, 508, 511; scopulorum, 510, 511; utahensis, 510, 511; virginiana, 499, 501, 503, 508–511
Sagittaria, 214; Engelmanniana, 62; lancifolia, 213, 217; latifolia, 62, 213; variabilis, 213, 215, 217
Salix, 358; discolor, 352
Salvia lanceolata, 551
Sambucus canadensis, 352
Sarcopyramis **delicata,** 72, 75
Sarothra gentianoides, 352
Sassafras, 571, 573, 575; Sassafras, 574
Sassafras, An analogy between the development of the plates of crinoids and the leaves of, 571
Saururus cernuus, 213, 217
Savastana odorata, 190
Saxifraga, 358
Scenedesmus, 241, 247; caudatus, 247; obtusus, 247
Scientific organizations in relation to the death of Lucien Marcus Underwood, Resolutions adopted by the Torrey Botanical Club and other, 41
Scirpus americanus, 480; cyperinus, 481, 482; cyperinus condensatus, 482; cyperinus pelius, 482; nanus, 480; occidentalis, 481; paludosus, 481; pedicellatus, 482; rubrotinctus, 481; robustus, 481; validus, 481
Schizachyrium scoparium, 181, 182; **littorale,** 182; villosissimum, 182
Schizaea, 29
Schizodendron, 250
Schizostipae, 378
Schoenocrambe linifolium, 546
Scleria triglomerata, 483
Scleroderma strobilinum, 294
Sclerospora Farlowii, 552; graminicola, 552
Scrophularia, 553; californica, 553; marylandica, 553; nodosa, 553; nodosa marylandica, 553
SEATON, S. The development of the embryo-sac of Nymphaea advena, 283
SEAVER, F. J. Color variation in some of the fungi, 307; North Dakota slime-moulds, 577; Some North Dakota Hypocreales, 527
Selaginella, 23, 29, 30; rupestris, 26
Senecio, 548; aureus, 548; aureus croceus, 548; cymbalarioides, 548; integrifolia, 548; Hartianus, 548; oblanceolatus, 548; lugens, 548; Mac Dougalii, 548; peninsularis, 548; Serra, 548; vulgaris, 548
Sequoia gigantea, 293
Serpicula angustifolia, 457; canadensis, 465; occidentalis, 457, 460, 463, 465; verticillata, 457, 459, 465; verticillata angustifolia, 459, 465
Setaria, 552
SETCHELL, W. A. Notes on Lycoperdon sculptum Harkness, 291
Sicyos angulatus, 550
Silene, 358, 543; antirrhina, 352, 543
Silphium integrifolium, 548; laciniatum, 548; perfoliatum, 548; terebinthinaceum, 548; trifoliatum, 548
Sinapis alba, 545, 546; arvensis, 546
Sisymbrium, 546; canescens, 546; incisum, 546; officinale, 546
Sisyrinchium, 353, 358
Slime-moulds, North Dakota, 577
Smilax, 358; rotundifolia, 353
Solanum Lycopersicon, 553; tuberosum, 553
Solidago, 548; canadensis, 352, 548; nemoralis, 352; Riddellii, 548; rigida, 548
Some Araucarian remains from the Atlantic coastal plain, 249
Some Echinocerei of New Mexico, 77
Some native weeds and their probable origin, 347
Some North Dakota Hypocreales, 527
Sonchus, 549; asper, 549
Sophia, 546; Hartwegiana, 546; incisa, 546; pinnata, 546
Sorbus, 508
Sorghastrum avenaceum, 182
Sorosporium, 147; Aristidae, 148; **consfusum,** 148; Ellisii, 147, 148; Ellisii Andropogonis, 148; Ellisii Aristidae, 148
Sorosporium Ellisii Winter, a composite species, 147
Sparganium, 215, 217; americanum, 58;

androcladum, 58; eurycarpum, 58; lucidum, 58
Spartina caespitosa, 194; cynosuroides, 194; glabra alterniflora, 194; glabra pilosa, 194; juncea, 194; patens, 194; polystachya, 194
Species, New or noteworthy, 361
Species of Closterium, The New England, 109
Species of Crataegus, Two imperfectly known, 577
Species of Evolvulus, Two Bahamian, 89
Species, Sorosporium Ellisii Winter, a composite, 147
Species and races: The genus Ernodea Swartz, a study of, 203
Specularia perfoliata, 352
Spergula arvensis, 543
Sphaeropsis malorum, 435
Sphenopholis palustris, 475; palustris flexuosa, 475
Spilocaea Pomi, 423
Spinacia oleracea, 548
Spiraea, 538, 540; alba, 539; alleghanensis, 541; arbuscula, 539; Aruncus americana, 541; Beauverdiana, 539; betulifolia, 539; caroliniana, 537; chamaedryfolia, 538; cinerascens, 541; corymbosa, 538; densiflora, 539; Douglasii, 540; Douglasii × densiflora, 540; Douglasii × lucida, 540; Hartwegiana, 538; Helleri, 539, 540; japonica, 539; latifolia, 539, 540; lucida, 538; Menziesii × densiflora, 540; Menziesii × lucida, 540; monogyna, 538; Nobleana, 540; obovata, 540; opulifolia, 535; opulifolia pauciflora, 538; parvifolia, 538; pauciflora, 538; pyramidata, 540; ribifolia, 536; roseata, 540; salicifolia, 539, 540; splendens, 538, 539; Steveni, 538, 539; subcanescens, 540; subvillosa, 540; tomentosa × alba, 540; tomentulosa, 540
Spirodela polyrrhiza, 353
Spirogyra, 226, 228, 230, 231, 233, 244; crassa, 230, 244; inflata, 230, 244; neglecta, 244; nitida, 226–228, 230, 244; rivularis, 244; varians, 227–230, 244; Weberi, 231, 244
Sporobolus vaginaeflorus, 191, 353
Sporogonium of Marchantia polymorpha, The development of the sexual organs and, 321
STANDLEY, P. C. Some Echinocerei of New Mexico, 77
Staurastrum, 109, 234, 245
Stegnosperma, 567; cubense, 567; halimifolium, 567
Stemonitis maxima, 578; Smithii, 578
Stenochlaena, 32, 33
Stichococcus, 237, 238, 246
Stipa avenacea, 191
Strobilomyces, 524
Structure in Carica Papaya, Correlation of flower- and fruit-, 141
Studies in North American Convolvulaceae, 97
Studies in North American Peronosporales, 361, 543
Studies in the genus Gymnosporangium, 499
Studies of West Indian plants, 337, 561
Study of species and races: The genus Ernodea Swartz, 203
Symbiezidium, 388; barbiflorum, 387, 388; **laceratum,** 386–389; transversale, 386; vincentinum, 387, 388
Synchytrium, 423
Syntherisma filiforme, 183, 353; humifusum, 183; sanguinale, 183, 353

Terebinthus, 341; **angustata,** 341, 342; **glauca,** 341, 342; **Hollickii,** 341; **inaguensis,** 341, 342; **Nashii,** 341, 342; Simaruba, 341; **simplicifolia,** 341, 342
Tetraspora, 241, 247; lubrica, 229, 241, 247
Thalictrum **philippinense,** 65, 74; purpurascens, 552
Thelypodium pinnatifidum, 546
Theobroma Cacao, 553
Thesium psilotoides, 65
Thlaspi glaucum, 546; Nuttallii, 546
Thysananthus, 178
Tilia americana, 578
Tilmadoche viridis, 578
Tiniaria dumetorum, 552; scandens, 552
Tissa leucantha, 543; marina, 543
Todea, 29
Torrey Botanical Club and other scientific organizations in relation to the death of Lucien Marcus Underwood, Resolutions adopted by the, 41
Trachylejeunea, 373–375; Aquarius, 374; **dilatata,** 372–375, 389; prionocalyx, 374, 375; Spruceana, 374
Tragopogon porrifolius, 549
Trametes conchata, 405; **conglobata,** 405; **insularis,** 405; Mulleri, 405
Tremella Botryapites, 506; clavipes, 506
Trianthema Portulacastrum, 361, 543
Trichilia **Harrisii,** 568; persimilis, 579
Trichodium laxiflorum, 192
Trichomanes, 29; Petersii, 25
Trichosanthes Anguina, 550, columbrina, 550
Tricuspis sesslerioides, 195
Tridens flava, 195
Trifolium, 358, 550; carolinianum, 550

Triglochin, 215; maritima, 62
Trillium, 25
Triplasis purpurea, 195
Tubers of plants, The water-storing, 271
Tubifera ferruginosa, 579
Two Bahamian species of Evolvulus, 89
Two imperfectly known species of Crataegus, 577
Two new grasses from the West Indies, 301
Tylodendron, 250
Typha, 224, 232, 235, 238; angustifolia, 58; latifolia, 58; orientalis, 63
Tyromyces **Merrittii,** 406; **subchioneus,** 406; **unguliformis,** 406
Udora, 457, 458; canadensis, 459–461, 465; verticillata minor, 462, 463, 465
Ullmannia, 250
Ulothrix, 237, 246; aequalis, 237, 246; subtilis, 246; zonata, 238, 246
Underwood, Lucien Marcus, biographical sketch of, 1; A memorial tribute, 13; Resolutions adopted by the Torrey Botanical Club and other scientific organizations in relation to the death of, 41; The published work of, 17; Relation to the work of the New York Botanical Garden, 39
Unona clusiflora, 68
Uredo nootkatensis, 501
Urtica, 530; gracilis, 352, 553
Urticastrum divaricatum, 553
Uvaria **rubra,** 68, 74; **scandens,** 69, 74
Vallisneria spiralis, 62
Variation in some of the fungi, Color, 307
Vaucheria, 238, 240, 241, 243, 246; geminata, 235, 246; geminata racemosa, 240, 241; sessilis, 240, 246
Verbena urticaefolia, 352
Verbesina encelioides, 548
Vernonia Baldwinii, 548; noveboracensis, 548
Veronica, 553; alpina, 553; Anagallis, 553; Anagallis-aquatica, 553; arvensis, 553; peregrina, 553; Wormskioldii, 553
Vibrio acerosus, 121; Lunula, 122
Viburnum acerifolium, 546; dentatum, 546; nudum, 546; Opulus, 546; pubescens, 546
Vicia, 550; americana, 550; americana linearis, 550; Faba, 550; linearis, 550; sativa, 550
Vincetoxicum, 544; gonocarpos, 544; hirsutum, 544; suberosum, 544
Viola, 352, 354, 358, 486; odorata, 554; Rafinesquii, 554; tenella, 554; tricolor, 554; tricolor arvensis, 554
Vitis aestivalis, 554; bicolor, 554; californica, 554; cinerea, 554; cordifolia, 554; Labrusca, 554; riparia, 554; rotundifolia, 554; vinifera, 554; vulpina, 554
Vittaria, 29
Voltzia, 250

Walchia, 250
Water-storing tubers of plants, 271
Wedelia incarnata, 543
Weeds and their probable origin, Some native, 347
West Indian Lejeuneae, New, 371
West Indian plants, Studies of, 337, 561
West Indies, Two new grasses from the, 301
WESTER, P. J. The correlation of flower- and fruit-structure in Carica Papaya, 141
Whipplea modesta, 553
Whitfordia, 407; **Warburgiana,** 407
WILSON, G. W. Studies in North American Peronosporales, 361, 543
Woodsia, 29
Woodwardia, 29; paradoxa, 33
Work of Lucien Marcus Underwood, The published, 17

Xanthium, 352; canadense, 544
Xanthoria, 299; **modesta,** 298

ZAHLBRUCKNER, A. New North American lichens, 297
Zannichellia, 215–217; palustris, 60, 214
Zanthoxylum americanum, 532
Zizania aquatica, 190
Zostera marina, 62
Zygnema, 231, 244; cruciatum, 231, 244; leiospermum, 231, 244; insigne, 231, 244

THE BRYOLOGIST

WITH THE JANUARY, 1908, NUMBER BEGINS ITS

ELEVENTH YEAR AND VOLUME

It is a 16–20 page bi-monthly devoted to the study of the Mosses, Hepatics, and Lichens. It is fully illustrated with new, original, and artistic drawings and half-tones. It is indispensable to the working bryologist, professional as well as amateur. Send for sample copy. Subscription price $1.00 a year.

Address, MRS. ANNIE MORRILL SMITH, 78 Orange Street, Brooklyn, N. Y.

INDEX TO AMERICAN BOTANICAL LITERATURE

This Index, printed each month in the BULLETIN, is reissued on library catalogue cards; these are furnished to subscribers at the rate of one cent for each card.

Subscriptions to the card-issue may be addressed to the Treasurer of the Torrey Botanical Club,

WILLIAM MANSFIELD, COLLEGE OF PHARMACY, 115 W. 68th St., N. Y. City.

Beginning with January, 1903, the Index has also been reprinted on paper, on one side only, and can be furnished in that form at the rate of $3.00 a year.

North American Flora

THIS work is designed to present descriptions of all plants growing independently of cultivation, in North America, here taken to include Greenland, Central America, the Republic of Panama, and the West Indies, except Trinidad, Tobago, and Curaçao and other islands off the north coast of Venezula, whose flora is essentially South American.

It will be published in parts at irregular intervals by the New York Botanical Garden through the aid of the income of the David Lydig Fund bequeathed by Charles P. Daly.

It is planned to issue parts as rapidly as they can be prepared, the extent of the work making it possible to commence publication at any number of points. The completed work will form a series of volumes with the following sequence:

Volume 1. Mycetozoa, Schizophyta, Diatomaceae.
Volume 2 to 10. Fungi.
Volumes 11 to 13. Algae.
Volumes 14 and 15. Bryophyta.
Volume 16. Pteridophyta and Gymnospermae.
Volumes 17 to 19. Monocotyledones.
Volumes 20 to 30. Dicotyledones.

The preparation of the work has been referred by the Scientific Directors of the Garden to a committee consisting of Dr. N. L. Britton, Dr. W. A. Murrill and Dr. J. H. Barnhart.

Professor George F. Atkinson, of Cornell University, Professors Charles R. Barnes and John M. Coulter, of the University of Chicago, Mr. Frederick V. Coville, of the United States Department of Agriculture, Professor Edward L. Greene, of the United States National Museum, Professor Byron D. Halsted, of Rutgers College, and Professor William Trelease, of the Missouri Botanical Garden, have consented to act as an advisory committee.

Vol. 7, Part 1, Ustilaginales, including Ustilaginaceae and Tilletiaceae, by G. P. Clinton, was issued Oct. 4, 1906. Vol. 7, Part 2, Coleosporiaceae, Uredinaceae, and Aecidiaceae (pars), of the Uredinales, by J. C. Arthur, was issued March 6, 1907. Vol. 9, Parts 1 and 2, Polyporaceae, by W. A. Murrill, were issued Dec. 19, 1907, and March 12, 1908. Vol. 22, Part 1, including Podostemonaceae by George V. Nash, Crassulaceae by N. L. Britton and J. N. Rose, and Penthoraceae and Parnassiaceae by P. A. Rydberg, was issued May 22, 1905. Vol. 22, Part 2, including Saxifragaceae and Hydrangeaceae by J. K. Small and P. A. Rydberg, Cunoniaceae, Iteaceae, and Hamamelidaceae by N. L. Britton, Pterostemonaceae by J. K. Small, Altingiaceae by Percy Wilson, and Phyllonomaceae by H. H. Rusby, was issued Dec. 18, 1905. Vol. 22, Part 3, Grossulariaceae by F. V. Coville and N. L. Britton, Platanaceae by H. A. Gleason, Crossosomataceae by J. K. Small, Connaraceae by N. L. Britton, Calycanthaceae by C. L. Pollard, and Rosaceae (pars) by P. A. Rydberg, was issued June 12, 1908. Vol. 22, Part 4, Rosaceae (pars) by P. A. Rydberg, was issued Nov. 20, 1908. Vol. 25, Part 1, including Geraniaceae by L. T. Hanks and J. K. Small, Oxalidaceae and Linaceae by J. K. Small, and Erythroxylaceae by N. L. Britton, was issued Aug. 24, 1907.

The subscription price is fixed at $1.50 for each part; it is expected that four or five parts will be required for each volume. A limited number of separate parts will be sold at $2.00 each. Addres

THE NEW YORK BOTANICAL GARDEN
BRONX PARK, NEW YORK CITY

PUBLICATIONS BY OFFICERS AND STUDENTS OF THE DEPARTMENT OF BOTANY, COLUMBIA UNIVERSITY

1. MEMOIRS OF THE DEPARTMENT:

Vol. 1. A Monograph of the North American Species of the Genus *Polygonum* (1895). By John Kunkel Small, Fellow in Botany, 1893–1895; Curator of the Herbarium, 1895–1898.

Quarto, 178 pages, 84 plates. Price $6.00.

Vol. 2. A Monograph of the North American Potentilleae (1898). By Per Axel Rydberg, Fellow in Botany, 1896–7.

Quarto, 224 pages, 112 plates. Price $6.00.

2. CONTRIBUTIONS FROM THE DEPARTMENT:

Vol. 1. Nos. 1–25. 1886–1892. Price $5.00.
Vol. 2. Nos. 26–50. 1892–1894. Price $5.00.
Vol. 3. Nos. 51–75. 1894–1895. Price $5.00.
Vol. 4. Nos. 76–100. 1895–1896. Price $5.00.
Vol. 5. Nos. 101–125. 1896–1897. Price $5.00.
Vol. 6. Nos. 126–150. 1897–1898. Price $5.00.
Vol. 7. Nos. 151–175. 1898–1901. Price $5.00.
Vol. 8. Nos. 176–200. 1901–1902. Price $5.00.
Vol. 9. Nos. 201–. 1903–(current).

List of separate numbers available on application.

3. A Text-book of General Lichenology (1896). By Albert Schneider, Fellow in Botany, 1895–1896.

Octavo, 230 pages, 76 plates. Price $4.25 (cloth); $3.80 (paper). Published by Willard N. Clute & Co. Binghamton, N. Y.

The Department invites propositions relative to exchanges of herbarium material for any of the above named publications. Address Dr. Carlton C. Curtis, Columbia University, N. Y. City.

4. An Illustrated Flora of the Northern United States, Canada, and the British Possessions from Newfoundland to the Parallel of the Southern Boundary of Virginia, and from the Atlantic Ocean westward to the 102d Meridian (1896–1898). By Nathaniel Lord Britton, Professor of Botany, 1891–1896; Emeritus Professor 1896–, and Hon. Addison Brown.

Three volumes, royal octavo. Vol. 1, 612 pages; Vol. 2, 642 pages; Vol. 3, 588 pages; 4162 figures in the text, illustrating every species described.

Published by Charles Scribner's Sons, New York. Price, in cloth, $9.00 for the three volumes; with the indexes and keys bound separately. $10.00.

5. Our Native Ferns and their Allies. (Sixth Edition) 1900 By Lucien Marcus Underwood, Professor of Botany, 1896–1907.

Duodecimo, 158 pages, 35 figures. Published by Henry Holt & Co., New York. Price, $1.00.

6. Moulds, Mildews, and Mushrooms. By Lucien Marcus Underwood, Professor of Botany, 1896–1907.

Duodecimo, 236 pages, 10 plates. Published by Henry Holt & Co. Price $1.50.

7. Nature and Development of Plants (1907). By Carlton Clarence Curtis, Assistant in Botany, 1892–1895; Tutor in Botany, 1895–1906; Instructor in Botany, 1906–.

Octavo, 471 pages; 42 illustrations. Published by Henry Holt & Co., New York. Price $2.50.

ESTABLISHED 1851

EIMER & AMEND

205–211 Third Ave.,
Corner 18th Street

NEW YORK

MANUFACTURERS AND IMPORTERS OF

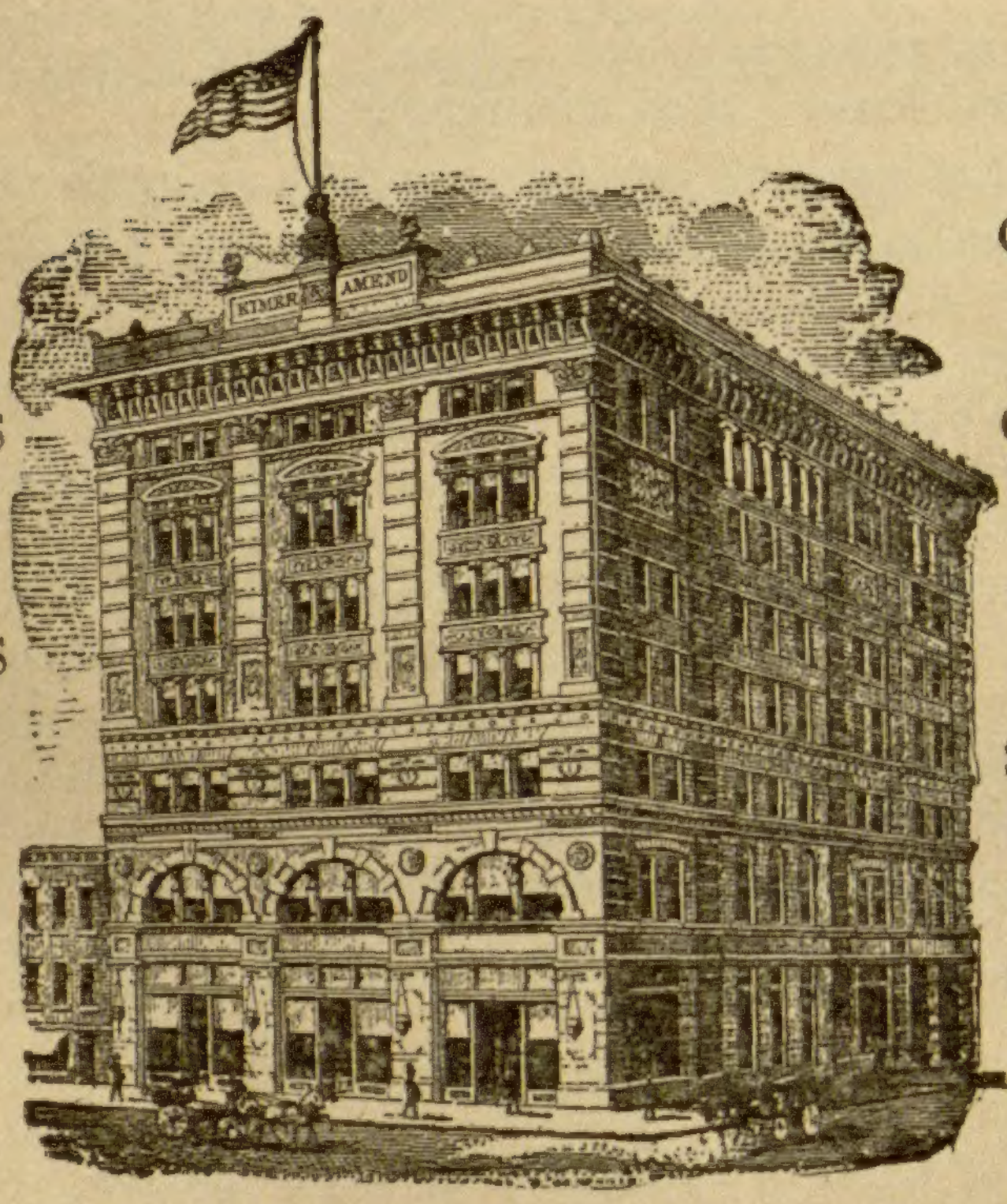
Chemicals and Chemical Apparatus

Our Specialties

MICROSCOPES
and
ACCESSORIES

MICROTOMES

BALANCES
and
WEIGHTS



Sole Agents for

C. A. F.
KAHLBAUM'S
C. P. Chemicals
and Reagents

CARL
SCHLEICHER
& SCHÜLL'S
C. P. Filters

SCHOTT &
GENOSSEN'S
Famous Laboratory Glassware

And for many other renowned European houses in our line.

COMPLETE LINE OF

Bacteriological Apparatus

WE HANDLE

EVERYTHING NEEDED FOR A LABORATORY

Inspection of premises cordially invited.

MEMOIRS OF THE TORREY BOTANICAL CLUB

A series of technical papers on botanical subjects, published at irregular intervals. Price $3.00 a volume. Not offered in exchange.

Vol. 1, No. 1; not furnished separately:

Bailey, Liberty Hyde. Studies of the types of various species of the genus *Carex*. Pages 1–85. 25 My 1889.

Vol. 1, No. 2; not furnished separately:

Martindale, Isaac Comly. Marine algae of the New Jersey coast and adjacent waters of Staten Island. Pages 87–111. 24 Au 1889.

Vol. 1, No. 3; price, 75 cents:

Spruce, Richard. *Hepaticae* Bolivianae, in Andibus Boliviae orientalis, annis 1885–6, a cl. H. H. Rusby lectae. Pages 113–140. 20 Ja 1890.

Vol. 1, No. 4; price, 75 cents:

Sturtevant, Edward Lewis. On seedless fruits. Pages 141–187. 30 My 1890.

Vol. 2, No. 1; not furnished separately:

Halsted, Byron David. Reserve food-materials in buds and surrounding parts. Pages 1–26, *plates 1, 2.* 10 S 1890.

Vol. 2, No. 2; price, 75 cents:

Vail, Anna Murray, & Hollick, Charles Arthur. Contributions to the botany of Virginia. Pages 27–56, *plates 3, 4.* 23 D 1890.

Vol. 2, No. 3; not furnished separately:

Holm, Herman Theodor. Contributions to the knowledge of the germination of some North American plants. Pages 57–108, *plates 5–19.* 15 Ap 1891.

Vol. 2, No. 4; price, 75 cents:

Wheelock, William Efner. The genus *Polygala* in North America. Pages 109–152. 30 D 1891.

Vol. 3, No 1; not furnished separately:

Small, John Kunkel, & Heller, Amos Arthur. Flora of western North Carolina and contiguous territory. Pages 1–39. 20 F 1892.

Vol 3, No. 2; price, $2.00:

Morong, Thomas. The *Naiadaceae* of North America [with illustrations of all the species]. Pages 1–65, *plates 20–74.* 15 Mr 1893.

Vol. 3, No. 3; not furnished separately:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. [Part 1.] Pages 1–67. 28 Ap 1893.

Vol. 4, No. 1; not furnished separately:

Underwood, Lucien Marcus. Index *Hepaticarum.* Part I, Bibliography. Pages 1–91. 10 Je 1893.

Vol. 4, No. 2; not furnished separately:

Small, John Kunkel, & Vail, Anna Murray. Report on the botanical exploration of southwestern Virginia during the season of 1892. Pages 93–201, *plates 75–82.* 18 N 1893–17 Ap 1894.

Vol. 4, No. 3; price, 50 cents:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 2. Pages 203–274. 10 Mr–17 Ap 1895.

Vol. 4, No. 4; price, 50 cents:

Pettit, Anna Stockton. *Arachis hypogaca* L. Pages 275–296, *plates 83–85* 5 Je 1895.

Vol. 4, No. 5; price, 75 cents:

Rydberg, Per Axel. The North American species of *Physalis* and related genera. Pages 297–374. 15 S 1896

Vol. 5; price, $3.00:

List of *Pteridophyta* and *Spermatophyta* growing without cultivation in northeastern North America. Pages 1–377. 4 D 1893–31 D 1894.

Vol. 6, No. 1; price, $1.25:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 3. Pages 1–130. 17 N 1896.

Vol. 6, No. 2; not furnished separately:

Grout, Abel Joel. A revision of the North American *Isotheciaceae* and *Brachythecia*. Pages 131–210. 30 Jl 1897.

Vol. 6, No. 3; price, 50 cents:

Hazen, Tracy Elliot. The life history of *Sphaerella lacustris* (*Haematococcus pluvialis*). Pages 211–246, *plates 86, 87* (*colored*). 8 Je 1899.

Vol. 6, No. 4; price, 50 cents:

Underwood, Lucien Marcus. A review of the genera of ferns proposed prior to 1832. Pages 247–283. 1 D 1899.

Vol. 6, No. 5; price, 25 cents:

Fink, Bruce. Notes on lichen distribution in the upper Mississippi Valley. Pages 285–307. 1 D 1899.

Vol. 7; price, $3.00:

Howe, Marshall Avery. The *Hepaticae* and *Anthocerotes* of California. Pages 1–208, *plates 88–122*. 5 Au 1899.

Vol. 8, No. 1; not furnished separately:

Lloyd, Francis Ernest. The comparative embryology of the *Rubiaceae*. Part I. Pages 1–26, *plates 1–4*. 26 Au 1899. Part II. Pages 27–112, *plates 5–15*. 15 F 1902.

Vol. 8, No. 2; price, $1.00:

Evans, Alexander William. The *Lejeuneae* of the United States and Canada. Pages 113–183, *plates 16–22*. 15 F 1902.

Vol. 8, No. 3; price, 75 cents:

Britton, Elizabeth Gertrude, & Taylor, Alexandrina. The life history of *Vittaria lineata*. Pages 185–211, *plates 23–31*. 30 Au 1902.

Vol. 9; price, $3.00:

Salmon, Ernest Stanley. A monograph of the *Erysiphaceae*. Pages 1–292, *plates 1–9*. 4 O 1900.

Vol. 10; price, $3.00:

Burgess, Edward Sandford. History of Pre-Clusian botany in its relation to *Aster*. Pages i–xii, 1–447. 22 N 1902.

Vol. 11, No. 1; price, $1.75:

Griffiths, David. The North American *Sordariaceae*. Pages 1–134, *plates 1–19*. 30 My 1901.

Vol. 11, No. 2; price, $1.75:

Hazen, Tracy Elliot. The *Ulothricaceae* and *Chaetophoraceae* of the United States. Pages 135–250, *plates 20–42*. 20 O 1902.

Vol. 12, No. 1; price, $1.50:

Northrop, Alice Rich. Flora of New Providence and Andros (Bahama Islands). Pages 1–98, *plates 1–19 + map*. 10 D 1902.

Vol. 12, No. 2; price, $1.00:

Banker, Howard James. A contribution to a revision of the North American *Hydnaceae*. Pages 99–194. 13 Je 1906.

Vol. 12, No. 3; price, 75 cents:

Kupfer, Elsie. Studies in plant regeneration. Pages 195–241. 10 Je 1907.

Vol. 13; price, $3.00:

Burgess, Edward Sandford. Species and variations of Biotian Asters, with discussion of variability in *Aster*. Pages i–xv, 1–419, *plates 1–13*. 15 Mr 1906.

Vol. 14, No. 1; price, $1.25:

Burlingham, Gertrude Simmons. A study of the *Lactariae* of the United States. Pages 1–109, *figures 1–15*. 26 My 1908.

Address: **TORREY BOTANICAL CLUB,**
Columbia University, New York City.